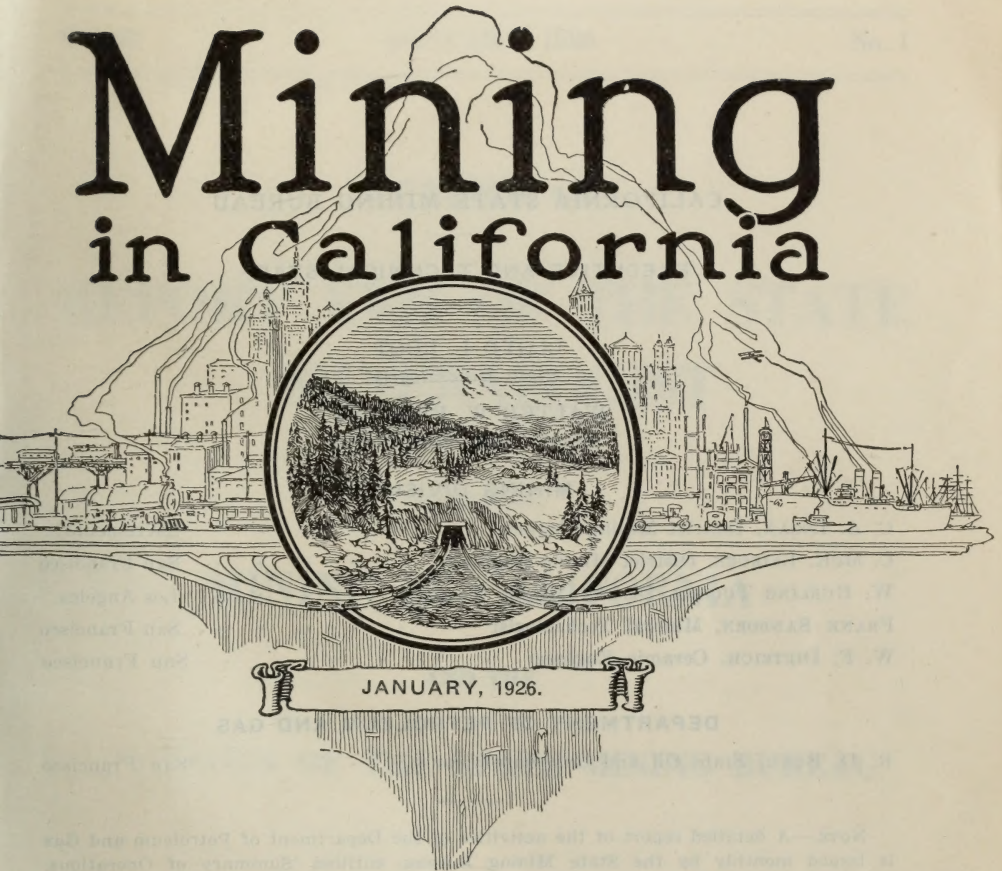


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Mining in California



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NOTE.—A detailed report of the activities of the Department of Petroleum and Gas is issued monthly by the State Mining Bureau, entitled 'Summary of Operations, California Oil Fields.'

CALIFORNIA STATE MINING BUREAU

FERRY BUILDING, SAN FRANCISCO

LLOYD L. ROOT

State Mineralogist

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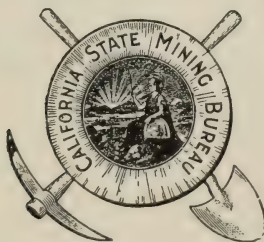
REPORT XXII OF THE STATE
MINERALOGIST

COVERING

MINING IN CALIFORNIA

AND THE

ACTIVITIES OF THE STATE MINING BUREAU



CALIFORNIA STATE PRINTING OFFICE

JOHN E. KING, State Printer

SACRAMENTO, 1926

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CALIFORNIA STATE MINING BUREAU
LLOYD L. ROOT
STATE MINERALOGIST

OUTLINE MAP OF CALIFORNIA

SCALE



PREFACE.

The State Mining Bureau is maintained for the purpose of assisting in all possible ways in the development of California's mineral resources.

As one means of offering tangible service to the mining public, the State Mineralogist for many years has issued an annual or a biennial report reviewing in detail the mines and mineral deposits of the various counties.

The weak point in work of this character has been that the results of field investigations were so long in preparation that they had lost much of their usefulness by the time they finally appeared in print.

As a progressive step in advancing the interests of the mineral industry, publication of the Annual Report of the State Mineralogist in the form of monthly chapters was begun in January, 1922, and continued until March, 1923.

Owing to a lack of funds for printing, quarterly publication was begun in September, 1923.

For the same reason, beginning with the January, 1924, issue, it has been necessary to charge a subscription price of \$1 per calendar year, payable in advance; single copies, 25 cents apiece. 'Mining in California' will continue to be sent without charge to our exchange list, including schools and public libraries, as are also other publications of the State Mining Bureau.

Pages are numbered consecutively throughout the year and an index to the complete reports is included annually in the closing number.

Such a publication admits of several improvements over the old method of procedure. Each issue contains a report of the current development and mining activities of the state, prepared by the district mining engineers. Special articles dealing with various phases of mining and allied subjects by members of the staff and other contributors are included. Mineral production reports formerly issued only as an annual statistical bulletin are published herein as soon as returns from producers are compiled. The executive activities, and those of the laboratory, museum, library, employment service and other features with which the public has had too little acquaintance also are reported.

While current activities of all descriptions will be covered in these chapters, the Bureau will not discontinue its practice of issuing from time to time technical reports on special subjects. A list of such reports now available is appended hereto, and the names of new bulletins will be added in the future as they are completed.

The chapters will be subject to revision, correction and improvement. Constructive suggestions from the mining public will be gladly received, and are invited.

The one aim of the Mining Bureau is to increase its usefulness and to stimulate the intelligent development of the wonderful, latent resources of the State of California.

DISTRICT REPORTS OF MINING ENGINEERS.

In 1919-1920 the Mining Department was organized into four main geographical divisions, with the field work delegated to a mining engineer in each district working out from field offices that were established in Redding, Auburn, San Francisco and Los Angeles, respectively.

This move brought the Bureau into closer personal contact with operators, and it has many advantages over former methods of conducting field work.

To continue this system most effectively with the limited funds available for the present biennium, the Redding and Auburn field offices were consolidated and moved to Sacramento on June 1, 1923.

The boundaries of each district were adjusted and the counties now included in each of the three divisions, and the locations of the branch offices, are shown on the accompanying outline map of the state. (Frontispiece.)

Reports of mining activities and development in each division, prepared by the district engineer, will continue to appear under the proper field division heading.

Although the petroleum industry is but little affiliated with other branches of mining, oil and gas are among the most valuable mineral products of California, and a report by the State Oil and Gas Supervisor on the current development and general conditions in the state's oil fields is included under this heading.

New County Reports.

The series of separate reports on the mines and mineral resources of the different counties, that together comprise the State Mineralogist's Reports XIV to XVII, inclusive, in the case of many of the counties have become exhausted. Those still in stock are in need of revision. It has been thought advisable, therefore, beginning with the January, 1925, issue of 'Mining in California,' to make the district engineers' reports in the form of a complete general report on the mines and mineral resources in one or more of the counties in each district.

This program will be followed as near as possible in succeeding numbers of the quarterly until each county in the state has been covered.

SACRAMENTO FIELD DIVISION.

C. A. LOGAN, Mining Engineer.

TRINITY COUNTY.

Foreword and Acknowledgment.

Field work for this report was carried on during the summer and autumn of 1925, several trips having been made to different parts of the county. The mining industry of the county has received a good deal of attention in the reports of both the United States Geological Survey and the California State Mining Bureau, during recent years, and because the industry has been very quiet there for the past ten years, it was not found necessary to carry on extended field work. Considerable time was spent, however, visiting placer mines along Trinity

River between Helena and Salyer, quartz mines and placers in the Carrville and Coffee Creek districts, and numerous quartz mines and prospects in other scattered districts. Time was also taken to bring the record of location and ownership of mining property up to date. In spite of the amount of valuable information heretofore printed on the county's mines, most of this is not now available, due to exhaustion of stock of both federal and state publications.

It is also true that even if all these reports were available, they are all fragmentary. It is the plan of the present report to furnish a comprehensive idea of the mineral resources of the entire county. Notes taken by the writer during the past season and in previous field work cover operations not described in other publications, and these other publications have in turn been drawn upon, in cases where there has been little or no recent development. An innovation, and it is hoped an improvement, is introduced by separating purely statistical information, such as ownership, location, and extent of holdings, from the discussion of geology and mine development, putting the former details in separate tables to economize time and space. The characteristics of individual mines are discussed separately, where the properties appear to warrant it, and where operations have been of such an extent as to reveal interesting and informative facts.

The assistance of operators and mine owners throughout the county is acknowledged with pleasure and special thanks are due to Fritz Meckel, Junction City; Harvey Stofer and Charles D. Trask of Helena; J. H. King, French Gulch; B. R. Brown, A. C. Meckel and E. E. Harriگان, Weaverville; John Boddecker and Williams Brothers, Coffee; and J. M. Dikeman, Bonanza King Mine.

Geography.

Trinity County, lying in the northwestern part of the state, embraces nearly the entire drainage basin of Trinity River and its branches, and like Siskiyou County is made up of a succession of mountain chains and deep canyons. This mountain region, known by the general name of the Klamath Mountains, is composed of a number of disconnected chains, lacking the symmetrical arrangement of the Sierra Nevada. These mountains are the connecting links between the Sierra Nevada and Coast Range Mountains. While the Coast Ranges of California are characterized by rounded, gently sloping hills, and broad shallow valleys, the Klamath Mountains are more abrupt in relief. The streams have carved deep, precipitous canyons, except on the upper reaches of the main river, in the northeastern part of the county, and on the Hayfork, where there are comparatively extensive areas of level and arable land. Upon these lands, a little farming is carried on, although the distance to outside markets and the lack of local demand discourages this, and stock raising and mining are the principal industries. Except where the Northwestern Pacific Railroad crosses the extreme southwest corner, there are no railroads within the county, the principal supply point being Redding, in Shasta County, 48 miles from Weaverville, the county seat. Daily mail and passenger stages travel between Redding and Weaverville and other points. The state highway lateral between the two points has not been completed, but is generally in good condition, and greatly facilitates travel. Roads

extend from Weaverville to Carrville via Minersville and Trinity Center, and from Redding to these points via French Gulch; also from the state highway at Douglas City to Hayfork and thence to the coast, via Peanut and Bridgeville in Humboldt County. A good highway also extends from Junction City along the river to the westerly county line at Salyer, connecting with the coast system of highways in Humboldt County. Salyer is 40 miles east of Korb, the nearest railroad point. A toll road runs from Delta to Trinity Center, but has little travel. The mines of the Carrville-Coffee Creek district are 30 to 45 miles from the railroad at Delta or Redding.

The timber and water resources of the county are especially abundant, with many perennial streams. The exception to this is a stretch of 40 miles along the north side of the river, extending from Douglas City downstream. In this region the streams are small and the country dry with a sparse growth of digger pine, but south of the river the streams are stronger and the timber cover better.

The area of Trinity County is 3166 square miles and the population was only 2550 in 1920. The county seat and only town of any size is Weaverville, having about 600 inhabitants and situated at an elevation of 2047 feet in a large area of gold-bearing gravel, but with few active mines at present. Junction City, 12 miles west of Weaverville by road on Trinity River, and Douglas City, on the river and on the state highway lateral 8 miles south of Weaverville, were formerly active hydraulic mining camps. Trinity Center and Lewiston are headquarters for the dredging operations on the river. Carrville, Helena and French Gulch (the last named in Shasta County) are the nearest points to the principal quartz prospecting operations.

Hotel accommodations are available at Weaverville, Junction City, Helena, Big Bar, Lewiston, Minersville and Carrville, but at the last named only in summer and fall.

GEOLOGY AND MINERAL RESOURCES.

Summary of Geology of Quartz Mining Districts.

The quartz mines of the county occur in three principal belts. One is on the east side of the county, forming part of a large area of Bragdon (lower Carboniferous) rocks, in which black carbonaceous slate is the most important member. This area extends from Tower House in Shasta County and from near Lewiston in Trinity County, northward to Carrville, and contains numerous formerly productive quartz mines, in both counties. The second area is one of ancient rocks classified as pre-Cambrian metamorphics,¹ occupying a section of country from 12 to 18 miles wide extending in a northwesterly direction from the southern border in the region of Bully Choop Mountain, past Weaverville and as far as the headwaters of the Salmon River in Siskiyou County. Prominent in this area is hornblende schist, varying from fine to coarse grained. This is the wall rock of the veins north of Dedrick. Many varieties of intrusive rocks occur within the older schist. Diorite and granodiorite and various porphyritic rocks are prominent. The granitic rocks occur as large areas, notably on Weaver Bally, in the Thompson Peak region, and west of Helena. Some veins of ore occur in the granodiorite, but the periphery of the

¹ Smith, J. P., Cal. State Min. Bur. Bull. 72 and Geologic Map of Cal.

granitic intrusive is a more favorable location for prospecting, particularly in case of a large area.

In the northeastern part of the county, and also in the western section, occur a series of rocks grouped by Hershey and others as the greenstone series, and termed by J. P. Smith,¹ "Paleozoic metamorphics, undifferentiated." This series contains slate and slaty schist, altered igneous rocks of various ages, crystalline limestone and large areas of serpentine. A lack of fossils has prevented the exact placing of the various members in the time scale, but the group may contain Devonian, Carboniferous and earlier formations. In the area from Trinity Center northward, and from the western part of Shasta County as far west as Callahan, serpentine is especially prominent. Other rocks of igneous origin which are important because of their connection with ore deposits of the Carrville-Coffee Creek section, are the dikes and larger bodies of granodiorite and granodiorite porphyry (dacite porphyry) and basalt (quartz-augite diorite) and lamprophyre dikes. Mac Donald² believed that the granodiorite intrusions occurred in the late Jurassic or earliest Cretaceous, and noticed that at least in places the serpentine dikes (probably originally peridotite) cut the granodiorite, which itself is older than the other igneous rocks mentioned.

In the first mentioned district, in the eastern part of the county in the Bragdon slate area, the gold quartz deposits are in the form of narrow fissure veins usually with slate for one wall and diorite porphyry, soda granite porphyry or some other intrusive dike rock for the other. Quartz is the principal gangue mineral, and pyrite, galena, sphalerite and arsenopyrite occur. The ores of these mines are comparatively high grade with most of the gold of coarse size and only a little sulphide. Many pocket deposits have also been found in this district, nearly all occurring along faulted contacts of the slate and altered andesite. These pocket deposits were studied many years ago by Oscar H. Hershey and described as follows by him:³

"At the contact the black rock frequently has a shining luster and a schistose structure due to shearing. This gives it imperfectly the power of a gouge to deflect underground waters. The volcanic rock near the contact has generally been decomposed, softened, and changed to a dull-brown color; it is popularly known as porphyry. In places there is a thin vein of quartz between the so-called porphyry and the black schistose material, but generally they are in actual contact or separated merely by a thin seam of ferruginous dirt. The dirt seam often carries a little free gold, but the pockets are said to be found near or where seams of quartz penetrate the porphyry downward from the contact. The gold lies in a thin, flat sheet upon the igneous rock and under the slate, and in some cases extends a short distance into the former formation, rarely into the latter. It is in the form of coarse and fine grains that have a peculiar smooth and rounded surface quite unlike the free gold in quartz veins.

"The reason that the slate-volcanic rock contact is the great 'pocket' horizon is that it is there that the gold-bearing solution first reaches a carbonaceous rock—the carbon precipitates the gold. The water may

¹ Smith, J. P., op. cit.

² Mac Donald, D. F., Bull. U. S. Geol. Survey, No. 530 D.

³ Hershey, O. H., Origin of Gold Pockets in Northern California. Min. and S. P. Vol. 101, pp. 741-742.

reach the contact by traveling nearly horizontally through inclined strata or by ascending under hydrostatic pressure. The sheared slate so frequently found along the contact aids in holding the solution to it while the gold is being deposited. Probably also water issuing from the slate carries the precipitating agent. For a long time the point of union between the precipitant and the gold-bearing water remains at one place or near the contact, and thousands of dollar's worth of gold is thrown down within a space of a few cubic yards or less."

The leading mine of the fissure vein type in this region is the Brown Bear, at Deadwood. It has been developed to a depth of about 800 feet, although geologically similar veins in the same district nearby in Shasta County have proven profitable to much greater depths. The pocket deposits have, as a rule, been exploited only by shallow pits and adits, as the pocket hunter is a grass root miner, averse to deep mining, and not financially able to follow it, although often highly skilled in his particular form of mining. Pocket mining continues to be remunerative to a few miners in this district in both counties, and scarcely a season passes without the report of one or more good-sized pocket discoveries, often running into thousands of dollars. A few mines of this type have been opened by underground workings and have continued to pay over a period of years. The Five Pines is an example.

The mines in the second area, in the pre-Cambrian metamorphics, have varying characteristics. Those in the region of Bully Choop have wide veins, carrying fine gold and considerable sulphide, principally pyrite and copper sulphides and the ores become baser with depth, and are low or medium grade. A little farther north, numerous small mines have been worked where ore has been found rich enough to stand the expense of hauling to the railroad and shipment to a smelter. The ores of these mines in the vicinity of Indian Creek, carry nearly equal weights of gold and silver, and show galena, zincblende, and copper carbonates and sulphides. The veins are generally narrow and developments shallow. On Weaver Bally, some prospects have been opened in the hornblende schist, where the veins occur as small lenses of white quartz frozen to the walls, and carry bunches of high grade free gold ore, with only a small quantity of pyrite. The Fields-Meckel and Patillo prospects, described herein, are in this district. Farther north the Globe Mine in the hornblende schist has been a good producer, yielding high grade ore with finely divided free gold and little sulphide. The geology of these mines is covered elsewhere in this report.

In the Carrville district, the gold lode deposits are of different types. Mac Donald¹ described five types. The characteristics of these will be covered farther on, and it will suffice to say here that the ore deposition in every case appears to have been associated with one or another of the various igneous intrusives, either as a replacement of a dike, or as the result of ore deposition in shear zones, combined with partial replacement of the igneous wall rock, or as fissure fillings in one such rock accompanied by shearing, and small dikes of another intrusive. More active quartz prospecting is going on in this district than elsewhere in the county.

In the district north of Helena some blanket veins near the contact of granodiorite and diorite and with either of these formations for

¹ Mac Donald, D. F., op. cit

both walls, have paid well. The Enterprise-Lone Jack is the best known and is described. Farther north, a number of veins have been prospected in the region tributary to the East Fork of North Fork of Trinity River, but no production is going on, although several owners are actively working.

The New River district, which at one time had several active mines, is at present nearly deserted by quartz miners.

Summary of Geology of Auriferous Gravel Deposits.

Since none of its streams empty into navigable rivers, all forms of placer mining have prospered without hindrance in Trinity County, and the La Grange mine, the largest hydraulic mine in existence at the time, was operated until the late war, but present operations of this kind are small. In recent years one of the more important gold dredging fields has been developed along Trinity River between Lewiston and Carrville, and this branch of the industry has supplied most of the gold produced since 1918.

The area containing Trinity County's gravel deposits has passed through three separate and lengthy periods of erosion, according to Diller.¹ The earliest of these was the period during which the Klamath peneplain was formed. Hershey² believed this was during the Cretaceous. This peneplain was a very important feature, but today only remnants of it are preserved, and can be seen best from some high mountain, from which vantage point it will be noticed that the summits of many of the higher ranges have approximately the same elevation, representing remaining parts of the peneplain, which was reduced nearly or quite to sea level during the Cretaceous. The erosion of the previously formed gold lode deposits, during this and following periods, supplied the gold for the placer deposits, but no important placer gravel deposits have been worked on this peneplain in Trinity County.

The uplift following the formation of the Klamath peneplain was followed by a second cycle of erosion, and the formation of a second peneplain, 500 to 1000 feet lower than the first and corresponding to the Sherwood peneplain, in the neighboring coast counties.³ Large and important deposits of gravel were formed during the development of the Sherwood peneplain in this county, and these were preserved by being faulted downward into basins where they were protected by rims of harder rock, as shown by the detailed studies of Diller and illustrated by various figures in his paper on Auriferous Gravels of Trinity River Basin,⁴ and by the earlier work of Mac Donald.⁵ The best example of a mine in the gravel of this age is the La Grange, which has become universally known in recent mining literature because of the magnitude of the former operations. This mine lies at the southwest end of an area of auriferous gravel and glacial till (or 'dead wash') that extended from a short distance southwest of Weaverville to the vicinity of Trinity Center, and had an average width of one to three miles from Weaverville to the East Fork of Stuarts Fork, but which north of there has been eroded by glaciers. This large area is in

¹ Diller, J. S., *Bulls. U. S. Geological Survey* Nos. 196, 470, 540.

² Hershey, Oscar H., *Am. Geologist*, Vol. 25, 1900, p. 86; Vol. 27, p. 245.

³ Diller, J. S., *Bull. U. S. Geol. Survey* No. 196.

⁴ Diller, J. S., *Bull. U. S. Geological Survey*, No. 470, pp. 11-29.

⁵ Mac Donald, D. F., *Bull. U. S. Geological Survey*, No. 430.

the so-called Weaverville Basin, where the deposit reaches a thickness perhaps as great as 1000 feet and has been mined for a depth of 650 feet in the La Grange Mine. On the west it is bounded by a distinct fault, easily seen in the La Grange workings, and striking east of northeast there. The stratification planes of the gravel dip toward the fault plane, but the surface of the country slopes east and southeast toward the river. Weaverville has an elevation of 2047 feet, while the summit of the La Grange hill, which has been nearly reached by the mining operations, and shows washed gravel, is at an elevation of 3200 feet. In the immediate region of Weaverville the recent and present streams have eroded and reconcentrated this old high gravel and detrital material, which forms the bedrock for the later accumulations.

Other areas of gravel of age and character similar to the La Grange-Weaverville deposits occur on Duttons Creek at the Sweepstakes and Lower Duttons Creek Mines, on Browns Mountain, on Musser Hill, above Trinity River near Lowden, across Indian, Redding and Browns Creeks, southeast of Douglas City, in Hayfork Valley and in Hyampom Valley.

No other mine in gravel of this age has been opened on a scale comparing with the La Grange, although small operations have been carried on in several places. In some cases the gravel is cemented and could not be worked profitably. The cost of water installations on these areas, which are mostly around 3000 feet in elevation, is also an important factor and the water controlled by a few of the larger companies would be needed for their exploitation. The La Grange company's rights could be utilized to the greatest advantage. In general, the gravel of this age is of such low gold content that it can be profitably worked only on a large scale, judging by the average yield in the La Grange operations and in prospecting work carried on by the same company on other areas. The numerous small hydraulic mines worked near Weaverville in years past, (where the Lorenz and Hook & Ladder still continue) have been in deposits formed by the action of recent streams which enriched the gravel while reconcentrating it, making it rich enough to pay handsomely. Lack of grade and dump are factors now and increase the cost of operation by lowering the duty of water, whether it be used for piping up to the boxes and stacking tailing or in hydraulic elevators.

Study of fossil leaves taken from the gravel of this age has resulted in the conclusion that the gravel is of the same age as the earlier gravels of the Sierra Nevada, and the location of the different deposits suggests their deposition by the main Tertiary Trinity River.

The youngest gravels are those forming the bar and bench deposits along the present river and its tributaries. These extended through Quaternary and recent time up to the present. Such deposits occur, where conditions have been favorable, along the entire stream from the tributaries of Coffee Creek in the extreme northeast corner of the county downstream to the mouth of the river, in Humboldt County. The very youngest of these gravels lie in the present bed and lowest bars of the river, and are being worked profitably by several dredgers in the section of the main river between Lowden and Trinity Center. This is free wash gravel, with mostly small to medium sized boulders. Farther upstream on the main river and on Coffee Creek near Carrville, gravel was drilled and reported of good grade. In the latter place a

dredger was installed but some of the boulders encountered were too heavy to permit successful operation. There is still considerable unworked gravel along Coffee Creek. The stream has been noted for the production of coarse gold but work along it has been hampered by the size and number of boulders, and in many claims by lack of grade and dump. Pat Holland's Placer Mine, on the East Fork of Coffee Creek has been operated every season for the past 50 years. There are a number of small placer mines which were being worked by one or two men each on the other forks of the creek during the past summer. Some are drift mines in the gravel below the present stream, others hydraulic or ground sluice mines. Near Minersville, the resumption of hydraulic mining has been promised for the present season on the Beaudry Mine.

Going downstream from Lowden on the main river, no activity is noted in the Douglas City district, except at the Union Hill Mine, and only a little work has been done each season in recent years in the Junction City district. The latter district is an interesting one to the geologist, although it has passed its peak in gold production. There has been here a greater development of low bench deposits than anywhere else on the river, and these must have been rich as they have been nearly worked off. The gravel on these benches between the mouth of Dutch Creek and the Jacob Mine is in part distinctly different in origin from the gravel farther upstream. In this section, the wash is characterized by many enormous boulders which have evidently not come downstream in the present river, as they are not seen above Dutch Creek. It is also interesting to note that these mines have produced many nuggets of platinum group metals (principally osmiridium) up to an ounce in weight, but that these metals disappear going upstream above Dutch Creek. No platinum was ever produced at the La Grange Mine. The large boulders may be from fault breccia or landslide material or from glacial debris brought from the north. At Dutch Creek the river changes its general course from southwest and west to nearly north, in line with, but opposite in direction to, the steep course of Canyon Creek, which enters it at Junction City. While no geologic work has been done to trace such a fault, it is possible that Canyon Creek and the northward flowing section of the river may occupy a fault. After passing Canyon Creek the river again turns westward and maintains this direction nearly to the county line where it turns north and receives New River and the South Fork of Trinity River. There is good hydraulic mining ground left near Junction City at the old Jacob claims; also on Canyon Creek, and small acreages at Helena and Big Bar. Between Big Bar and Burnt Ranch the river flows in a steep canyon carved in serpentine most of the distance, and in this section no important bench gravel deposits were formed. Large areas of unworked high bench gravels remain in the vicinity of Hawkins Bar and in the section adjacent to the south fork and main Trinity River near their confluence. In this latter region there is to be seen intact the most complete sequence of terraces anywhere on the river, as described farther on under the Hammer and Kahlke Mine.

On the South Fork near Auto Rest a company has been preparing for hydraulic mining during the past summer. Many claims have been held under placer locations for years along the Hayfork and South Fork

but only a little hand work has been done. On New River and its tributaries, Haley¹ noted a number of gravel bars which he considered might be profitably worked. There is little mining of any kind going on in this region west of Big Bar. Most of the properties lack the necessary water supply installations, and many are devoid of equipment, although there appear to be numerous excellent opportunities for developing paying mines. These can not all be described, but descriptions of several properties, representing the different types, are given in considerable detail. Haley's bulletin, cited above, should also be consulted by those interested, for informative notes.

Other Minerals.

In addition to gold, Trinity County contains deposits of asbestos, barytes, chromite, coal, copper, limestone, manganese, marble, mineral paint, mineral water, platinum group metals, quicksilver and building stone. Silver is produced as a by-product, being alloyed with gold. Due to the distance of most of the prospects from railroads, there has been only a limited development of the commercial mineral deposits and gold, silver, copper and platinum group metals have been the principal products. During the world war, many chromite and manganese properties were prospected and some production was made. Except for the prospects in the southwestern corner of the county, near the line of the Northwestern Pacific Railroad, and those in the northeastern section, all these were at long distances from railroads and have remained unproductive.

¹ Haley, Charles S., Cal. State Min. Bur. Bull. 92, pp. 92-93.

MINERAL PRODUCTION OF

Year	Gold, value	Silver, value	Quicksilver	
			Flasks	Value
Altoona Mine, before 1875 (est.)*	6	6	1,000	\$88,000
1875			1,500	126,425
1876			1,979	87,076
1877			1,317	49,129
1878			1,534	50,469
1879			1,919	57,282
1880			245	7,595
1881	\$326,693	\$142		
1882	550,000	1,500		
1883	600,000			
1884	400,000			
1885	529,150	\$334		
1886	338,148	10		
1887	464,726	219		
1888	553,051	924		
1889	589,000	500		
1890	811,632	640		
1891	1,192,790	259	240	12,600
1892	1,327,787	2,249		
1893	1,446,603	168		
1894	1,122,995			
1895	1,012,666	325		
1896	1,166,745	1,257	3,926	137,410
1897	1,296,330		4,205	139,035
1898	1,078,372	259	838	29,330
1899	859,255	314	4,032	151,200
1900	590,510	1,086	3,076	123,624
1901	571,605	\$7,935	2,294	105,982
	684,683	\$1,240	1,302	58,668
1902	719,992	550	240	10,251
1903	607,728	2,085	266	11,156
1904	574,814	135	102	3,864
1905	690,844	3,044	389	13,917
1906	560,843	2,981	166	6,059
1907	535,316	2,399	98	3,739
1908	602,944	4,269	90	3,808
1909	520,046	2,302	197	7,915
1910	500,851	1,960	133	5,622
1911	612,149	6,777	44	2,024
1912	723,503	7,494	18	758
1913	431,862	2,119	4	161
1914	743,512	3,374		
1915	441,846	3,470		
1916	435,403	7,591		
1917	602,048	10,021		
1918	444,729	6,912		
1919	538,494	3,872		
1920	541,387	3,469		
1921	437,993	1,390		
1922	182,918	2,432		
1923	617,841	5,816		
1924	422,281	10,934		
Totals	\$30,002,175	\$114,757	\$31,154	\$1,293,099

*Bradley, W. W., Quicksilver resources of California; Cal. State Min. Bur., Bull. 78, p. 200, 1918.

†Includes crushed rock, rubble, sand, gravel.

‡Lawver, A. M., in 'Production of Precious Metals in U. S.'; Report of Director of Mint, 1884, p. 175, 1885.

§Recalculated to 'commercial' from 'coining value' as originally published.

¶See under 'Unapportioned.'

*The metal contained in the 1919 product was 38% iridium and 62% platinum.

*No county segregated figures for gold and silver available for years earlier than 1880.

TRINITY COUNTY, 1875-1924.

[illegible]

ASBESTOS.

Chrysotile asbestos might reasonably be expected to occur in some of the numerous areas of serpentine in the county, and has been noted in several places, but little has been done to exploit these occurrences in recent years. About 12 years ago a company spent some money for equipment and prospecting upon claims near the East Fork of Trinity River in the vicinity of the old Altoona quicksilver mine. This company failed and the claims at present are being held by *Milton J. Brown*, Coffee P. O. Brown has four claims on which are some of the old machinery and buildings and the old sawmill of the defunct company. Castella, 20 miles east by road, is the nearest railroad station.

Rudolph Ott, Shasta P. O., Shasta County, has two claims five miles southwest of the Altoona quicksilver mine, on East Fork of Trinity River, three miles from the Castella road and 24 miles from Castella. He reports that he has not yet found asbestos in place. Asbestos float is found for a distance of five miles from Altoona to Whalen station on the Castella road.

CHROMITE.

Although some of the chromite deposits of the county are remote from the railroad, there was some production during the war from a number of localities.

In the region from Plummer Springs Ranger Station on the northwest to the headwaters of the South Fork of Trinity River and to Tedoc Mountain, there is an extensive occurrence of chert and associated bodies of serpentine. This area is from two to six miles wide, and contains numerous bodies of chromite, the largest of which is that at the Tedoc Mine, in Tehama County. The Trinity County deposits so far opened in this belt were mostly small. The largest producer in the county was the *Crow Creek Group* of claims in Sec. 14, T. 38 N., R. 6 W., on Crow Creek, a branch of the North Fork of East Fork of Trinity River, 18 miles west of Castella. There are numerous other chromite properties in the same region, which is reached by way of the Ramshorn road, running from Castella westward to a point seven miles north of Carrville where it connects with the Carrville-Callahan road. The country rock in this region is principally serpentine, and the district is practically uninhabited except for summer visitors.

Highland Lake Claims produced some high grade chromite, which was hauled to Gibson, 14 miles northeast.

The Integral Chrome Mining Company did some mining on the extensive holdings of *Integral Quicksilver Mining Company*, which has over 2600 acres of land in Secs. 14, 15, 21, 22, 23 and 27, T. 38 N., R. 6 W., adjoining the Crow Creek Group on the south and 21 miles from Castella.

Mumbo Creek Group is in Sec. 4 or 11, T. 38 N., R. 6 W., one to two miles north of the Crow Creek Group.

Picayune Lake Group of 14 claims is still farther north, in Secs. 23, 26 and 27, T. 39 N., R. 6 W., and the nearest railroad station is Gibson, 16 miles northeast by trail and road.

Other claims, some of which produced small tonnages of chromite, were worked in the vicinities of Wildwood and Peanut. These were

a long way from the railroad, some as much as 75 miles. They have long since been abandoned.

Bibl: Cal. State Min. Bur. Bull. 76, pp. 209-212.

COAL.

Lignite occurs at numerous places in the county but has been used only locally for blacksmithing and domestic purposes. Probably all these occurrences were formed in Tertiary lakes or basins, such as the Weaverville basin or the smaller one at Big Bar. All the known occurrences are long distances from the railroad.

Big Bar Prospect. W. A. Pattison, Big Bar, owns hydraulic mines, now mostly worked out, one-half mile west of Big Bar post office on the south side of Trinity River, where lignite occurs as part of the strata underlying the bench gravel. Hydraulic mining has exposed the coal and a little of it has been used locally for blacksmith work.

The coal is exposed in a gulch for a distance of 250 feet, striking north and dipping west. It is evident that when the river flowed on this bench, the coal and associated shale and conglomerate formed a peninsula, surrounded except on the west by water. It is probably part of an ancient lake or marsh, and on the west the strata may extend a considerable distance under the old diggings, forming a basin of which the exposed edges are part of the rim.

The upper three feet of coal is fairly clean and increases to five feet thick where it passes under a gulch. On the west side of this gulch, this layer passes downward on the dip, and the bank above it shows six feet of brown shale with some seams of coal; one foot of coal; $1\frac{1}{2}$ feet of conglomerate; and five feet of mixed coal and sandy shale, with as much as three feet of coal in the widest part.

Some short prospect adits have been run. As the deposit is 77 miles by road from Redding, the nearest railroad point on the east, and nearly as far on the west, and there is only a very small resident population in the district, there appears little chance for profitable development.

In *Hayfork Valley*, in the river one and two miles downstream from Hayfork, two outcrops of lignite were found many years ago, and were described in our past reports, particularly in the Twelfth Report of the State Mineralogist. The coal is described as a black, tough lignite of good quality, and three separate layers, five, one and six feet in thickness, respectively, were noted. Numerous other exposures of lignite have been noted in this valley. The lignite was deposited in Tertiary, and possibly earlier, time as a part of the filling of an ancient basin of same age as the Weaverville basin. Hayfork is 65 miles by road from the railroad at Redding.

In *Hyampom Valley* where Hayfork Creek enters South Fork of Trinity River, numerous outcrops of lignite have been noted, and described in the above volume. Some of the layers of lignite are eight to ten feet thick, and are said to be of good quality, resembling other lignites found in Amador County and the Mount Diablo region. Only a little prospect work has been done upon these outcrops. Hyampom is nearly 90 miles by present roads from the nearest railroad point.

At *Poison Camp* in Secs. 22 and 15, T. 2 S., R. 6 E., H. M., lignite occurs in a vein three feet thick.

Near *Redding Creek*, seven miles southeast of Douglas City, Diller¹ noted "shaly coal 5 to 15 feet thick" occurs in the lower part of ancient gravel deposits.

Lignite has also been noted in the lower part of the gravel deposit mined at the Union Hill hydraulic mine near Douglas City, and in the bedrock of hydraulic mines in the Weaverville district.

Numerous analyses of Trinity County lignite were published in the Twelfth Report of the State Mineralogist, and indicate from 9% to 14% water, 34% to 47% volatile matter, from 19% to 42% fixed carbon, and a widely varying ash content, due probably to difference in degree of weathering of some samples.

Bibl: Cal. State Min. Bur. R. X, p. 716; XII, pp. 62-64; XIII, p. 56; XIV, p. 877. Bull. U. S. Geol. Survey, No. 470, pp. 21, 22, etc.

COPPER.

Copper prospects are found in areas of peridotite and serpentine and on their contacts with other rocks, in New River district, Carrville and Trinity Center district, adjacent to South Fork of Trinity River between Hyampom and Rattlesnake Creek, and in the extreme southwestern corner of the county, where geologic conditions are different and where the only important producer has been developed. All of these districts except the last named are so far from the railroad that little has been done with the prospects. It costs so much to haul ore to the railroad that only a very rich ore or concentrate would yield any profit. Hauling from either the New River or South Fork districts would be out of the question at present prices for copper. This leaves only the Carrville-Trinity Center district and Island Mountain district of possible interest at this time. No active mining or prospecting of copper properties was going on in the Carrville region during 1925. For information regarding old properties, the reader should consult the references cited under bibliography. No new field work was done in this connection.

Island Mountain Consolidated Copper Mine. Owner, Island Mountain Copper Co., care E. R. Leach, 210 Hillside Ave., Piedmont, California. Frank A. Leach, president, 710 Easton Building, Oakland. This property is in Secs. 9, 10 and 15, T. 5 S., R. 6 E., close to the line of the Northwestern Pacific Railroad. It has been the principal producer of copper in the county. From 1892, when it was discovered, until the completion of the Northwestern Pacific, prospecting and development were carried on. Since then ore has been shipped to the Tacoma smelter, and at times a maximum of 1000 tons of ore a month was produced. It is claimed that 275,000 tons of ore was proven, of which a small part has been shipped.

The ore contains copper and iron sulphides, and some gold, silver and zinc. It is said to average 3½% copper, 1½ ounces silver and up to two dollars a ton gold. The outcrop has been traced 800 feet on the strike and has a maximum width of 130 feet. The claims extend diagonally across Lake Mountain, around which Eel River makes a

¹ Diller, J. S., Bull. U. S. Geological Survey No. 470.

horseshoe bend. The old lower tunnel is 400 feet below the highest outcrops. The hanging wall is soft sandstone and the footwall shale. The ore body is thought to be 90 feet wide and 450 feet long and has been prospected by several thousand feet of workings.

Other groups of claims in the vicinity of Van Duzen River in the southwestern part of the county are mentioned in Bulletin 50.

Bibl: Cal. State Min. Bur. Bull. 50, pp. 140-150; R. XIV, pp. 878-882. Bull. U. S. Geol. Survey, No. 530 D, pp. 25-26.

GOLD QUARTZ MINES.

The geology of the various quartz mining districts has been covered in the introductory paragraphs of this report, in a general way, and more detailed notes are shown below for a number of mines. No attempt was made to visit all the idle quartz mines and prospects, but a sufficient number of those in each district which had not been adequately described in previous reports, are described in considerable detail so that the reader can obtain an idea of the various types of deposits in all parts of the county. The table of quartz mines and claims gives references to past publications of the State Mining Bureau and U. S. Geological Survey, which are available in this Bureau's offices, and which contain data regarding other properties, nearly all of which are idle at this time.

Quartz mining has been confined for the most part to prospecting during the past ten years in Trinity County, and much of the following is in the nature of history, but it is believed it will be helpful in showing what may be expected in developing properties of the same general types as those described. Very little ore has been milled in the county in recent years, and at times not a single mill has been in operation. Nevertheless, the person who is sufficiently acquainted with the county can not help realizing that many mines as good as those already worked remain undeveloped, because of the remoteness and inaccessibility of parts of the county.

The timber, water resources and possibilities for cheap mining are excellent. In many streams sufficient water is available for generating electric power for operating mining machinery.

Brown Bear Mine has been the largest quartz gold producer in the county, but has been idle, except for small-scale leasing operations, during the past 12 years. It was the principal mine of the Deadwood district, and a total production of \$8,000,000 has been claimed for it. This property has been covered in considerable detail in past publications, as will be noted by reference to the bibliography in the table. Mines in this region were not visited for the present report, but the following notes on this property are taken from a description written by H. G. Ferguson¹ in 1912, when the mine was in operation:

"The mine has been opened by crosscut tunnels at depths of 340, 395, 420, 520, 640, 725, and 1080 feet below the outcrop, besides several smaller old workings between the outcrop and the upper level. As two principal veins have been developed to a maximum distance of 1400 feet, besides drifts on minor veins, and the longest crosscut is about 2300 feet, it follows that there are several miles of workings. In the

¹ Ferguson, H. G., Bull. U. S. Geol. Survey No. 540, pp. 70-71.

short time available it was impossible to make more than a very hasty examination of a comparatively small part of the mine.

"There is a 10-stamp mill with two Wilfley tables, capable of handling about 20 tons a shift. In September, 1912, the force consisted of four miners and seven lessees.

"The country rock is slate of the Bragdon formation, cut by a large number of irregular intrusions that represent different types, including both diorite and soda granite porphyry.

"There is almost everywhere evidence of motion along the slate and porphyry contacts. At only one place was an intrusive contact without gouge seen. The veins lie for the most part in slate but also cut the porphyry. Besides numerous small veins and stringers two principal veins have been worked; these are parallel and have an average strike of N. 80° E. The northern vein, the Monte Cristo, dips steeply to the north; the Last Chance, 200 feet south of the Monte Cristo, dips south at angles between 60° and 80°. The width is as a rule not over two feet, more commonly about six inches, but stopes have been taken out to a width as great as 22 feet. Two small veins developed to some extent on the lower levels have strikes of N. 20° W. and N. 50° W.

"The ore shoots on the Last Chance vein appear to pitch at a rather flat angle to the east. The veins show slipping along both walls and there is always some gouge present, locally as much as three inches. The gouge carries fragments of quartz and a little gold. It is very rare that the ore is frozen to the wall.

"Quartz is the principal gangue mineral. Much of it has a cloudy blue-gray color and in many places it is banded, owing to inclusions of slate parallel to the walls. Calcite is comparatively rare in the ore and is more commonly seen in the small irregular stringers in the slate and porphyry near the veins. Manganese oxide is noticeable in the surface quartz. The sulphides consist of pyrite, galena, sphalerite, and arsenopyrite. The concentrates carry about \$100 in gold to the ton but form a very small percentage of the ore. Pyrite is the most common sulphide and is found both in the veins and impregnating the slate and porphyry walls. Small stringers of pyrite cut the slates near the veins, and the joint planes of the slate and porphyry are in places heavily pyritized. Galena and sphalerite show no tendency to migrate into the country rock and are found in the vein, their presence generally indicating rich ore. Although they are rare in the ore as a whole, in a few places the vein is almost entirely made up of these two minerals and pyrite. Arsenopyrite is almost exclusively confined to the altered porphyry where it occurs both in crystals scattered through the rock and in extremely minute crystals along joint planes. Visible gold is common. All the gold seen was in the quartz close to either an included fragment of slate or a patch of galena. Its fineness is about 0.840. The best ore of the present workings runs over \$100 a ton and the general run of ore as stoped is between \$20 and \$50."

Craig (Mason & Thayer) Mine is three miles southeast of Dedrick on the headwaters of East Fork of Canyon Creek at an elevation of 4200 feet. Leased with option to F. A. Hebbard et al. The property is reached by steep road via Junction City, and Redding, the nearest railroad station, is about 70 miles east.

According to Ferguson¹ "the vein is entirely within the hornblende schist, which here strikes N. 55° W. and dips 70°-85° S. * * * As in the Globe mine, the vein is a series of quartz lenses and cuts the schist at almost a right angle. The quartz, however, nowhere entirely pinches out, as in the Globe, but varies from three inches to six feet in width."

The vein has been prospected and ore blocked out by a series of three adits on one side of a gulch, and this gulch may indicate a line of faulting, as adit No. 4, on the other side of it, has been run beyond the point where the vein was expected, without striking it. No. 1 adit is 300 feet long, but caved in front. No. 2 is 67 feet lower and is 440 feet long and is said to be in the widest and best part of the vein, which is reported to have been lost on this level. No. 3 adit is 70 feet below No. 2 and is 740 feet long with a winze 38 feet deep 440 feet from the portal, and vein is said to be split in three parts in this winze. Two raises have been put up from No. 3 to No. 2 adit and the bulk of ore developed is in this block, the ore shoot being about 200 feet long and from 2½ to 7 feet wide, with a horse in the wider part.

Harvey Stofer, formerly superintendent, took 880 samples from all parts of the mine for the Crown Reserve Mining Company several years ago and reports these gave an average value of \$7.10 a ton for an average width of about three feet. The property has been idle since 1915, previous to which several operators worked without crushing much ore. A total of 315 tons of sorted ore is said to have averaged \$11 a ton free gold. The ore carries considerable pyrite, some in coarse cubes.

In the autumn of 1925, Hebbard was moving a 5-stamp mill to the property and planned to begin milling at an early date. There are several buildings on the claims.

De Cordi Prospect and *Dixie Queen Claim* both in the vicinity of Spring Gulch, three miles from the old camp of Indian Creek and eight miles by road and trail southeast of Douglas City, are typical of the district. The former shows complex ore with some malachite and azurite.

Dixie Queen Claim has produced \$5,000 to \$6,000 in high grade ore which yielded \$100 to \$384 a ton. The ore occurs in a vein six inches to one foot wide following a decomposed dike between 'porphyry' walls. Ore is base, containing about equal weights of gold and silver, with considerable galena and zincblende. It required smelter treatment, and the cost of mining, hauling, railroad freight and smelter charges was about \$50 a ton. Only assessment work was being done at claims in this region in 1925.

Democrat Group consists of 15 unpatented claims, 243 acres, named Democrat Nos. 1 to 15, 1½ miles from Weaverville on ridge between West Weaver Creek and Democrat Gulch.

What is termed the main vein has been prospected only by a few shallow holes and so far has not shown any ore. It runs northwest. Shallow workings along the west side of a serpentine dike, which strikes S. 77½° E. toward the main vein, have yielded several small bunches of rich gold ore, totaling perhaps \$5,000 to \$10,000. The

¹Ferguson, Henry G., Gold Lodes of the Weaverville Quadrangle, California. Bull. U. S. Geol. Survey No. 540, p. 78

pay was found in seams and stringers in the decomposed 'porphyry,' probably a basic intrusive originally, and the largest bunch was followed to a depth of 33 feet in a winze, where it is said to have pinched out.

A lower adit enters from Democrat Gulch at an elevation of 2350 feet (aneroid) and runs N. 60° E. through decomposed porphyry for 215 feet, where it crosses the serpentine dike 73 feet wide, and thence to the face for a distance of 75 feet is in black graphitic schist carrying quartz stringers. This quartz-bearing formation is straightening up near the face, with an easterly dip and strike northwest. It carries arsenopyrite up to eight per cent, but so far little gold.

Dorleska Mine adjoins the Yellow Rose Mine on the divide between the headwaters of Coffee Creek and South Fork of Salmon River at an elevation of 6500 to 7000 feet, and 16 miles by trail from Coffee or Trinity Center.

The geology of the deposit is similar to that of the Yellow Rose (which see), the two properties being on the same vein, which occurs in a fault zone at the contact of a lamprophyre dike and serpentine.

The mine was discovered shortly after the finding of the Yellow Rose, and the early history of the two was similar. The Dorleska was later equipped with a 5-stamp mill and subsequently five stamps more and a Huntington mill were added. The total production of the Dorleska is estimated to have been about \$200,000.

This mine was developed by a shaft 350 feet deep with three levels, and a winze 50 feet deep from the lowest of these is said to be in ore. Drifts are said to extend about 150 feet north and south in the soft, oxidized ore. The mine workings made considerable water, which presumably had a good deal to do with closing. A tunnel from the Salmon River side would give drainage. The property has been idle many years.

There are numerous other prospects and small mines in the vicinity showing little activity except annual assessment work.

Enterprise Mine. Lessees with option, Chas. D. Trask, Frank R. Brown, W. R. Beall, and H. D. Stirm. Mine address, Helena P. O. It is six miles by road north of Helena. Holdings are Enterprise No. 1 and No. 2, Cleve, Bo, Sunny, Hendy, Lonely Jack, Black Bone and Oak.

The outcrop of the Enterprise vein near the discovery point, according to Fritz Meckel, was partly in granodiorite and partly in diorite, and the vein was not displaced at the contact. The North Star workings, in the granodiorite, were not in as good ore as in the diorite. The property has been worked since 1884 and is said to have produced about \$500,000.

The Enterprise blanket vein dips 17° to 19½° west between diorite walls (on these claims). Several step faults move the vein from two to 15 feet with the quartz continuous through the breaks. The vein varies in width from six inches to six feet, and has little or no gouge. A prominent fault striking S. 60° E. and dipping about 47° N. cuts across the vein near the west faces of the Lonely Jack workings.

The most extensive workings have been upon the Lonely Jack claim, where the main adit was driven west and northwest for 1300 feet in the blanket vein. A large area of ground has been stoped out from

this level. Near the back of level, four winzes go down from a central point on an incline of 20° to 25° , being 160 feet deep on the incline or 52 feet deep vertically. These winzes and the lower workings are inaccessible, and maps of the workings have been stolen, but Fritz Meckel, a former lessee, states that 100 tons from the winze workings yielded \$6,500 and that a width of six feet of ore on the intermediate level (below the main adit) carried from \$7 to \$18 a ton in gold. Meckel and Skinner produced and milled 3000 tons of ore which yielded \$110,000. No ore yielding less than \$7 a ton could be worked at a profit. The pay was spotted and capriciously distributed, and a great deal of good looking but probably low grade quartz remains.

Outside the Lonely Jack workings on the same side of the canyon near the mill, other bodies of quartz parallel to the main vein have been shown by prospecting. Late in 1925 one such vein was uncovered by Mr. Trask who used a hydraulic monitor to wash off the soil overburden. This recalled the early placer operations in the creek, where the finding of gold in quartz led to the finding of quartz veins. The deposit appears to be a series of parallel blanket veins, with numerous quartz filled joint planes between, a condition promoted by the blocky nature of the country rock; but at this date little could be learned as to the distribution of the gold, although pay is said to have been better where the vein flattened.

The Enterprise claim on the opposite side of the creek has not been so extensively developed as the Lonely Jack but is stated to have yielded about \$100,000.

Water under 110 feet fall is taken from the East Fork of North Fork of Trinity River through 5400 feet of ditch, 1100 feet of pipe line and 2500 feet of flume two by three feet, and is used for generating electricity and operating the water-power mill. The mill contains 10 stamps of which five are in good shape, and there are a compressor and several good buildings. Active work was planned for the winter of 1925-26.

Fields-Meckel Prospect comprises seven unpatented 20-acre quartz claims called Klondyke, General Lee, Lone Star and Mt. Bally Nos. 1 to 4, on unsurveyed land on the south slope of Weaver Bally, at an elevation of about 6000 feet, 12 miles from Weaverville and reached only by trail. A millsite about a mile south and 1000 feet lower is also claimed.

The lowest adit is at 5810 feet elevation and follows the vein N. 75° E. for a distance of 230 feet. The vein is from six inches to two feet wide and forms small lenses of solid white quartz, the longest of which is 35 feet long. There is a raise 32 feet above the adit. The vein is tightly frozen to both walls, which are hard hornblende schist. The best showing so far on the property was at the portal of this adit, where \$2,500 is said to have been extracted from a hole two feet deep on the vein. The vein shows six inches of quartz at the face, and is said to pan well in fine free gold as far as drifted. It shows free gold in places. There are three other adits, the lowest, now caved, being 50 feet below the one described, and two short ones recently started 100 feet and 150 feet above the main adit. All these are in an area of a few acres and the rest of the claims are unprospected except for shallow pits, although the vein is said to be traceable for 2000 feet.

Assessment work only is being done and there is no equipment except hand tools.

Five Pines Mine has been active at intervals during late years and during 1925 has been under lease and option to James Skeen and partners. It is on the road between French Gulch and Trinity Center, two miles east of Trinity River. Skeen has been unwatering and prospecting the property. The geology has been covered in reports mentioned in the bibliography.

Globe Consolidated (Globe, Chloride and Bailey) Mine lies four miles north of Dedrick, at an elevation of 6100–6700 feet, near the top of a mountain between Canyon Creek and Stuarts Fork.

The mines included in this group were discovered in 1889 and the first recorded production made in 1891, when 1113 tons from the Chloride group produced \$22,000; small runs from the Bailey averaged \$12 and \$40 a ton, and 30 tons from the Globe group averaged \$30 a ton. The Chloride and Globe groups at the time each had a 3½-foot Huntington mill.

The Globe vein (and other undeveloped veins parallel to it) consists of shattered white quartz in a series of lenses. At the point of Joe Van Zeile's discovery, it was 3½ feet wide, but varies in width from 18 inches to 36 feet and was mined for a width of 9 or 10 feet in several places. Both walls are hornblende schist. According to H. G. Ferguson¹ the gold in the vein is so finely divided as to be invisible to the eye, and "the best ore is generally found along the hangingwall." Spots and stains of manganese oxide are considered as favorable indications. The vein occupies a shear zone nearly at right angles to the schistosity of the wall rock.

The vein has been explored and mined through a system of adits of which the principal ones worked in later years are Union adit, 500 feet long and 500 feet below the apex; No. 1 adit, 75 feet below Union; No. 2, the main working adit, 202 feet below Union adit, and 1700 feet long, extending entirely through the mountain from the Stuarts Fork side to the Canyon Creek side; and No. 3 adit, 149 feet below No. 2, giving a maximum depth of about 850 feet explored, and a maximum length of 1700 feet on the strike. The intervals between lenses of quartz were generally not over 20 feet for this entire distance, and the quartz lenses averaged about 200 feet long. In the Union workings an ore body 60 to 80 feet long in the form of a lens with a maximum width of nine feet was worked. Apparently the same ore shoot was proven from the bottom of No. 15 shaft (149 feet below No. 2 adit and 700 southwest of the face of No. 3 adit). Ore was stoped from below No. 2 level to a point 140 feet above Union level; on an easterly shoot from No. 2 level to above Union level, and at an earlier date from No. 3 to No. 2 level. No. 8 shaft and No. 15 shaft were each sunk about 149 feet below No. 2 level, and are 700 feet apart. The block of ground between these shafts has been only partially explored and is said to show 18 inches to two feet of ore that will assay \$25 to \$40 a ton, as far as opened. After the last company ceased work, Harvey Stofer obtained a lease on a block of ground above

¹ Ferguson, Henry G., op. cit., p. 77.

the Union level and mined good ore, but worked under difficulties on account of the number of times the ore had to be handled.

After the early period of activity, large operations began under Globe Consolidated Mining Company in 1910, and an expensive and complete plant, said to have cost \$150,000, was finished late in 1913. It included a 20-stamp mill, a cyanide plant of 100 tons daily capacity, an automatic tramway 5600 feet long, and numerous buildings. The mill was two miles from the mine, on Canyon Creek. This company continued work until late in 1918, and are said to have produced about \$300,000. In 1919 the mine was sold to Metals Exploration Company, who spent more than a year in exploration and preparation for milling, but made only short test runs. The Bailey tunnel, which entered the old Bailey claims below and to the southwest of the Globe workings, and No. 6 adit entering from the Canyon Creek side at the same level, would have given 600 feet more of backs below No. 3 level. This No. 6 level was continued a long distance in the direction of the Globe vein, but it is said results were disappointing. The company ceased work in 1920 and most of the machinery was removed. Old equipment for 10 stamps remains on the Stuarts Fork side. Water for power was taken from Canyon Creek through 6800 feet of flume and 2500 feet of 24-inch pipe.

Golden Jubilee Mine. D. C. and L. G. Williams, Coffee P. O., have a lease and option to purchase. It comprises 10 unpatented claims, covering 4500 feet along the strike, one mile south of Coffee P. O. at an elevation of 3000 feet.

The mine was discovered in 1892 and was operated until 1900, then lay idle until 1905. The old reduction plant contained two Huntington mills and a small cyanide plant. In 1908 a new mill of 10 light stamps and 30-ton cyanide plant was built but the property operated only a year or less, then lay idle until 1915. The last work previous to present operation was in 1916 by the California Extraction Co. The total production is claimed to have been 22,500 tons, which yielded \$150,000. Most of the gold realized came from 'high grade' ore which was shipped to a smelter.

The vein is a fissure filling in granodiorite about two miles south of a body of gabbro, and small lamprophyre dikes have been noticed in several places in the mine either in contact with or near the vein on the footwall side. The walls and vein are crushed by post-mineral shearing, but some of the branching quartz stringers, as in the lowest level, where they carry high grade ore, are frozen tightly to the walls, although even at this depth, 700 feet below the outcrop, the fissure shows a good sized gouge and considerable water. The vein strikes N. 30° E. to N. 20° W. and dips 80° E.

The vein has been developed by seven adits entering the steep mountain slope at elevations ranging from 3050 feet to 3700 feet, the deepest (No. 5) giving 700 feet of backs and having a length of 1400 feet in October, 1925. The present work is in No. 5 adit, which has been advanced 215 feet by the present lessees. Near the face they have lately sunk a winze (30 feet deep last October) where they encountered a narrow vein of high grade ore, showing free gold and telluride ore.

The vein pinches and swells and this work is in a narrow place. Beginning with the uppermost, the other levels are:

B	Elevation 3700 feet	Length 400 feet (caved)
A	Elevation 3600 feet	Length 440 feet
No. 1	Elevation 3500 feet	Length 440 feet
No. 2	Elevation 3400 feet	Length 680 feet
No. 3	Elevation 3350 feet	Length 680 feet
No. 4	Elevation 3300 feet	Length 700 feet

The ground between No. 4 and No. 5, over 200 feet on the dip, has not been explored. The outside ore shoot was stoped for a length of 300 feet and it varied in width from 18 inches to 10 feet between No. 3 and No. 1. In places the ore was oxidized to a depth of 300 to 400 feet but even between B and No. 1 levels assays indicated most of the gold in the sulphides. The middle ore shoot, about 80 feet long, was stoped from No. 3 to A level. The inside shoot, 110 feet long, is the one on which most of the estimates of ore reserves are based. The reserves claimed comprise 7157 tons of a total indicated value of \$111,000. This is between No. 2 and B levels, and would require a tram to deliver it to the mill, below No. 5 adit, unless a raise should be put through from that level. All the work has been upon the Grizzly claim. Another shoot is thought to exist under the Golden Jubilee claim, where the rich Onion Flat placers were worked up to the vein outcrop. Some extremely rich telluride ore has been taken from the mine in small lots.

Besides the 10-stamp mill, small cyanide plant and old Huntington mill, there is a 9" by 8" air compressor, two water motors, 1000 feet of 6-inch and 10-inch iron pipe, three concentrating tables, air drill equipment and several buildings. Water for power and milling is taken from Boulder Creek through one mile of ditch giving 235 feet fall, and the supply is ample.

In the old mill, a recovery of 93 per cent was claimed, using outside amalgamation, cyanide treatment of slimes by agitation and decantation, concentration of the sands and subsequent cyanidation of concentrate and tailing. Only about 20 per cent of the gold was recovered by amalgamation and the balance by cyanidation. There was one per cent of pyrite and galena, in part oxidized.

The *Poeth (Liberty) Wagner and Burner Mines*, all of the same type of deposit as the Golden Jubilee, are nearby on the north. None are active at present, although all have been small producers in the past. The *Dewey, Lily of the Valley* and *Sunshine* prospects are also located nearby. All of these mines and prospects are in the same area of granodiorite, which is about four miles long north and south and two to three miles wide. The Golden Jubilee is the most extensively developed property in the district.

Headlight Consolidated Quartz Mine is two miles by trail and road southeast of Carrville on the east side of Trinity River, and 600 feet above it. Sixteen years ago this property was the largest and most promising quartz mine in the district. In 1910 it was equipped with a 40-stamp mill, a cyanide plant of 250 tons capacity, electric power plant, sawmill and numerous buildings. The sulphide ore body was oxidized near the surface and operations were profitable for two years,

the ore having been worked by glory hole and drawn off by gravity through tunnels. But at a shallow depth fresh sulphide ore was found, carrying a great deal of pyrite and some copper, not amenable to treatment used on oxidized ore, and the plant was closed and removed. According to Brown¹ the production was \$500,000. The ore averaged about six dollars a ton in gold and operating cost was about \$2.40 a ton.

The geology of the property was covered in detail by Mac Donald² who describes it as "a replacement deposit in a basaltic dike where this dike cuts a larger dike of granodiorite porphyry, in a country rock of andesitic greenstone which is in contact with slate. Though no conclusive evidence of the matter was found, it is thought that the basaltic dikes were planes of weakness which yielded to shearing and thus afforded easy access to the acidic mineralizing solutions from the granite porphyry." This ore body was gossan capped, lay quite flat and covered over two acres, with thickness varying from 25 to 72 feet, averaging 40 feet. The soil overburden was stripped by hydraulicking.

The company claimed, in 1912, that 300,000 tons of ore remained proved as an ore reserve, of an average value of six dollars a ton. The last plant cost \$156,000.

Hidden Treasure Prospect is on the East Branch of East Fork of North Fork of Trinity River, 14 miles north of Helena, the last seven miles being by trail from the end of the road at the old Yellowstone mine.

An adit about 120 feet long has been run northwest from the north bank of the East Branch, following a seam. Fifty feet from the portal, the seam opens into a lens of quartz with a basic dike. The vein has a maximum width of three feet and dips 50° SE. This lens is about 50 feet long. The quartz shows some pyrite. Idle.

John Boddecker Prospect contains three quartz claims just west of Coffee P. O. On the Katherine claim there is an adit 150 feet long of which 75 feet is on the vein. Some good ore was milled from this. On the Josephine claim, an adit was run 75 feet and a winze which was sunk 25 feet is said to show three feet of ore, and some rich ore was taken from this years ago. On the Virginia claim, an adit was driven 50 feet. There are three separate veins and the geology is similar to that of the Golden Jubilee Mine. Only assessment work is being done.

Keating (Hardscrabble) Quartz Mine is on a deposit geologically similar to that mined in the Dorleska and Yellow Rose mines. It is northwest of Coffee P. O. in the high mountains, and reached only by trail. Fifteen years ago it was equipped with a 2-stamp mill, operated by an 8-h.p. gasoline engine. Some production was made, but for several years the property has been idle due to the death of a former operator, and has been for sale.

Liberty Group of six claims extends along Boulder Creek, a tributary of Coffee Creek, for 5500 feet beginning near the mouth less than one mile from Coffee P. O. Geologically the claims resemble the Golden Jubilee, which adjoins on the east. A shaft, now nearly full of water, is reported to be 145 feet deep and is said to show a vein

¹ Brown, G. Chester, Cal. State Min. Bur. R. XIV, pp. 892-893.

² Mac Donald, D. F., Bull. U. S. Geol. Survey No. 530 D, p. 17.

averaging 20 inches wide, which gives high assays. Drifts 30 feet long have been run each way on the vein from this shaft, and a short adit has been run. High grade ore of a total value of \$7,000 is said to have been sorted and shipped during the sinking and drifting work, years ago. Lately the claims have been idle. The ore carries tellurides and sulphides. There is some ore on the dump, but probably it is not high grade enough to repay the cost of hauling, shipment and smelter treatment, which would be \$25 a ton or more.

There is no reduction equipment. Water is available in Boulder Creek for power and milling.

McClaren Group (Trinity Group, Last Chance and Mountain Bell) is 14 miles north of Helena of which distance one-half is by trail from the Yellowstone Mine. The East Branch of East Fork crosses the claims which cover 4500 feet on the strike. The principal work at present is on Trinity No. 1 claim. An adit from the south bank of the creek is on a vein averaging 15 inches wide for a length of 105 feet, when quartz pinches for 50 feet. On the north bank, at an elevation of 2650 (aneroid) an adit runs N. 35° E. for a length of 250 feet on the vein, which stands nearly vertically and has a width of 36 inches near the portal, but is narrower inside. The wall rock is micaceous and amphibolitic schist, containing considerable limestone. Winzes have been sunk 31 feet and 41 feet deep, respectively, in the south and north drifts. The owner states that an average width of 13 inches of quartz showed an average value of \$16 a ton in gold for 133 feet in the north drift and 105 feet in south drift, and ore is 16 inches wide and assays \$16 a ton in the north winze. The ore shows a little free gold and small amount of sulphides and is reported to carry telluride in places.

On the Mountain Bell claim an adit was run 300 feet and for 130 feet followed a vein reported to be four feet wide and to assay \$9.72 a ton. An adit 60 feet long has been run on the Last Chance claim, showing 30 inches of quartz, and shallow work has been done on other claims. The owner works alone. There is ample timber on the claims and water for milling in the East Branch.

Paul Patillo Prospect comprises three unpatented quartz claims called Snowshoe, San Miguel and Montezuma, 60 acres, at the head of West Weaver Creek, on south slope of Weaver Bally, and adjoining Fields-Meckel prospect, 12 miles from Weaverville and accessible only by trail.

The vein strikes N. 75° E. and is being prospected by short adits, the longest having been driven 50 feet as a crosscut and 20 feet on the vein at time of visit in August. The vein makes small lenses similar to those in the Fields-Meckel claims, and is probably an extension of the same vein. It carries finely divided free gold. Assessment work only is done.

Rainbow Prospect is near the Bully Choop road, three miles north of Bully Choop mine. In the autumn of 1925, the owner, D. C. Dedrick, was prospecting a flat blanket ledge, which in places was three feet wide, with serpentine hangingwall and birdseye porphyry footwall. The vein outcrops at intervals for 500 feet, striking northwest and dipping east. Good pan prospects are obtainable at several places in the soft oxidized upper portion and in the gossan. The shallow adits

and pits are on a steep hillside and the vein is broken and not yet proven for any distance underground, but appears promising.

Sunshine Prospect is one-fourth mile west of Coffee P. O. and belongs to John Rau. There is a drift 75 feet long on a vein assaying \$7.80 a ton. It lies between granodiorite walls and is geologically similar to the Golden Jubilee.

Trinity Bonanza King Mine (United Trinity Mines) is about ten miles by road northeast of Trinity Center and is 36 miles by road from Delta. The lower workings and camp are on a steep mountainside at an elevation of 5200 feet, and may be reached by automobile during the dry season. The outcrop of vein is 1000 feet higher than No. 7 adit, which is on the same level as the camp. The entire holdings comprise about 2800 acres, including Bonanza King and Bonanza Queen groups of 116 quartz claims and 28 millsite claims, and the Bugle Hill Placer of 320 acres. The quartz claims extend in a north-westerly direction from the East Fork of Trinity River in section 30, T. 37 N., R. 6 W., for $4\frac{1}{2}$ miles. Bugle Hill Placer comprises the south one-half of section 36, T. 37 N., R. 7 W. Only part of the holdings are patented.

The mine was worked 35 years ago by Vollmers and associates of Trinity Center, and had a 5-stamp mill. It was purchased in 1904 by James Treadwell and operated by him until the early part of 1907. A hydro-electric plant of 1000 h.p. capacity was erected on the East Fork and a power line seven miles long was built to the mine, where a 40-stamp mill and other buildings were erected. It is claimed that during his operations Treadwell produced \$1,250,000. Part of this came from rich pocket shoots found at intersections. Two of these yielded \$85,000 and \$240,000 respectively. The mine lay idle between 1907 and June, 1912, when work was resumed, and low grade ore was milled. In January, 1913, a snowslide wrecked the mill and killed two men. Since that time, operations have been rather irregular and have produced little. Twenty stamps of the mill were salvaged and placed at the present site, with boarding house, bunkhouse, office, blacksmith shop and other buildings grouped about it.

In the lowest or No. 7 level the vein shows a maximum width of nine feet of white quartz. It occurs in a shear zone in chlorite schist. The country rocks are gabbro and andesite, altered and sheared, and traversed by basic dikes. Serpentine and talc schist are prominent on this level. No. 7 is a crosscut 1373 feet to the vein, with a drift thence 890 feet northwest and 400 feet southeast. On the northwest a serpentine dike 50 feet wide cuts across the workings near the face and nothing has been found beyond it, although considerable prospecting has been done here. The southeast face is also in schist and serpentine, and the mineralization is supposed to be connected with the serpentine. The southeast drift was presumably run to connect with a drift run 1500 feet northwest from the Bonanza Queen side, but the connection has not been completed. A raise 350 feet long from No. 7 connects with No. 3 level. The old No. 2, No. 3 and No. 4 intermediate levels are in this block of ground, but are caved and have not been opened by the present company. Above the old No. 4 intermediate level, which is 76 feet below No. 3 level, most of the vein was stoped for a length of 400 feet and a height of 40 feet. No stoping is reported below this.

No. 3 level is a crosscut 513 feet to the vein, then drifted 175 feet southeast and 600 feet northwest, of which 250 feet of the latter was new work done by the present company up to November 1, 1925, after catching up and retimbering the old drifts. They report this shows a fissure five feet wide, with ore for a length of 50 feet in the top of the drift.

Former operators stoped for a length of 350 feet above No. 3, and to a height of 25 to 35 feet; also for a similar length and height above No. 2 level, which is 210 feet above No. 3. It is about 600 feet on the dip of vein from No. 3 to the outcrop. The big bonanza shoot was found on No. 2 level and this shoot and another pocket shoot are thought to rake northwest, judging from the location of 'high grade.' The present aim is to extend No. 3 level northwest. Ore in the upper levels is said to have been under and beyond the serpentine dike.

During the past year considerable work has been done on the dam, flume and power line, and the available power supply permitted running the compressor and mill only one shift each. Work underground besides that done on No. 3 level was mostly putting up raises and retimbering old drifts. Four new raises, each 76 feet long, were put up from No. 4 to No. 3, and furnished 60 per cent of rock milled. No. 6 level was reopened for 225 feet, and new track laid. About 1000 tons, not all ore, was milled between March and November, 1925. Twenty men have been employed. Electric power is used throughout, including electric haulage of ore. The use of No. 7 level and raise does away with the need of an outside tram. The mill uses amalgamation only, and tailing runs to waste.

Trinity Mohawk Group of claims has been actively prospected during 1925. Ore for mill tests has been mined and hauled. The property was described in our monthly, MINING IN CALIFORNIA for October, 1922, and as this booklet is still available, it is not thought necessary to repeat a full description here. The property includes 11 claims and the Golden Oaks Group of three claims under the same ownership adjoins. On the Trinity Mohawk claims, a series of quartz veins occur on the contact of the black Bragdon slate and intrusive dikes of 'diorite porphyry.'

Yellow Rose Mine is partly in Trinity and partly in Siskiyou County, 16 miles by trail southwest of Coffee P. O. and 26 miles from Trinity Center. It was leased, in 1925, to C. J. Kerr and work was resumed after a long idleness. The mine is at an elevation of 6500 feet to 7000 feet near the top of the divide between Coffee Creek and South Fork of Salmon River. There are three claims.

The country rock is serpentine, which is traversed by numerous lamprophyre dikes. One of these dikes, 60 feet wide and striking N. 10°-16° E. with a dip of 75° W. forms the hangingwall of the deposit. This dike is locally called 'crows-foot porphyry,' but according to Mac Donald¹ has about the composition of camptonite on the east side, and kersantite on the west. The ore zone is in a prominent fault. The soft oxidized material has yielded some very rich ore. The property was discovered in 1897 by Hill and Farmer while 'pocket hunting' and the first reduction plant was an arrastra. According to John Bod-

¹ Op. cit., p. 9.

decker, some ore worth \$1,800 a ton was shipped. This occurred in a strip 20 feet long in a lens 140 feet in length, and was probably at the intersection of a cross fissure. Production so far has been all in free gold, but pyrite, galena and tellurides are reported in depth. A 3½-foot Huntington mill, using steam power, was employed, and the total output is placed at \$75,000.

The mine was developed by four adits. The lowest of these is 1400 feet long, and gives a depth of 450 feet on the vein. The next above is 170 feet higher and 710 feet long. The ground is soft, requiring timber. The vein varies from two to six feet in width. The present work is in a crosscut 650 feet long. There are reported to be backs of 345 feet left unworked on the vein above the lowest level, and there is still considerable length of unexplored vein between this mine and the nearest workings of the Dorleska Mine, which adjoins on the north. It is estimated that an adit 4500 feet long from the Taylor Fork of Salmon River would give 2000 feet of backs on the vein.

Yellowstone Mine of three patented claims adjoining the Enterprise Mine has been leased to the same parties as the latter.

This mine, a former producer with a record of \$160,000 to \$190,000 output has been idle for many years. It was developed by extensive workings, none at a very great depth, and a large shallow kidney of ore was mined. "A" level was run 780 feet following course of vein, east of northeast, and "B" level 680 feet above "A." Five other shorter adits were driven above these, the longest of them 400 feet. On "B" level, crosscuts were also run 120 feet northwest and 320 feet southeast in search of more ore. At this late date no definite information is available as to the mine's geology, and all workings are caved. The mill and other buildings and equipment long since fell to ruins.

TABLE OF QUARTZ MINES AND PROSPECTS, TRINITY COUNTY.

Name of mine	Location			Owner's name, address	Elevation, feet	Area, acres	Bibliography
	Sec.	Twp.	Range				
Alaska.....	15	35 N.	11 W.	R. H. Junkans, F. Shaw, Weaverville, and P. Zuella, Helena.....	3,100	120	R. XI, p. 482; XIII, p. 437; XIV, p. 884.
Amy Balch.....	13	33 N.	8 W.	M. G. Carter and B. C. Blair, 25 Willis St., Redding..... See Star of the East.	3,400	80	R. XIII, p. 437; XIV, p. 884.
*Annie McGrew.....	6	37 N.	12 W.	J. E. Miller.....	3,400	40	R. XIII, p. 437; XIV, p. 884.
Armstrong.....	16	8 N.	8 E.	Ladd Brothers.....	3,800	40	R. XIV, p. 884.
Big Chief.....	15, 16	34 N.	10 W.	J. E. Henry.....	4,300	20	R. XIV, p. 884.
*Bigelow.....	12, 13	33 N.	8 W.	Chas. Dobler, I. C. Lewis, 3978 Twenty-sixth St., San Francisco.....	3,500	15	
*Bismarck.....	8	37 N.	7 W.	Estate of George H. Blagrove, Carrville.....	3,000	20	R. XIII, p. 439; XIV, p. 884;
Blagrove.....	17, 18	37 N.	7 W.	Adams Exploration Company.....		450	U. S. G. S. Bull. 530 D, p. 21.
Blue Jacket.....							
Blue Jay.....	13	37 N.	8 W.	See New Blue Jay Mining Co.		40	
Boarding House.....	22	35 N.	8 W.	L. N. Dennison, Minersville.....	2,700	40	R. XI, p. 483; XII, p. 307; XIII, p. 439; XIV, p. 885.
Bonaanza.....	29	35 N.	8 W.	J. H. Tourtellotte, Weaverville.....	3,000	105	R. XIV, p. 885; XVIII, p. 207.
Bonanza.....	10	35 N.	11 W.	J. L. Johnston, Helena.....	6,500	2,500	R. XIII, p. 440; XIV, p. 876; XVII, p. 539; Pre. Rep. No. 8, p. 18;
Bonanza King.....	14	37 N.	7 W.	United Trinity Mines, 564 Market St., San Francisco.....			U. S. G. S. Bull. 530.
*Boston.....							
*Boulder Cons. G. Mines Co.....	7, 8	38 N.	5 W.	See Star of the East. Boulder Cons. G. Mines, 2401 Cimarron St., Los Angeles.....	6,000	161	
*Brooks Lode.....	24	9 W.	7 E.	Percy Grace.....		20	
*Brown Bear.....	11, 12, 13, 14, 16, 24	33 N.	8 W.	Thos. McDonald, R. A. Foster and Ella M. Smith, French Gulch.....	3,500	1,122	R. VIII, p. 639; X, p. 713; XI, pp. 483-84; XII, p. 308; XIII, pp. 440-41; XIV, pp. 885-86;
							U. S. G. S. Bull. No. 540, pp. 70-71.
Buck Mine.....	14	32 N.	9 W.	J. W. Phillips, Lewiston.....	2,900	40	R. VIII, p. 653; XIV, p. 886.

Bully Choop	4, 5, 8, 9	31 N.	8 W.	Bully Choop G. Mg. and Power Co., 805-6 Empire Bldg., Atlanta, Georgia	5,000	491	R. VIII, p. 640; XII, p. 308; XIII, p. 441; XIV, p. 886; XX, p. 182.
Carrie	5	37 N.	12 W.	G. Ferney	4,600	20	R. XIII, pp. 441-42; XIV, p. 886.
Chapman	33	38 N.	8 W.	W. Chapman	3,700	60	R. XIV, p. 886.
*Cleveland	4, 9, 16	31 N.	8 W.	Cleveland Consolidated Mining Company, Red Bluff	5,800	100	R. XII, p. 310; XIII, p. 442; XIV, p. 887.
Craig	4, 5 32, 33	34 N. 35 N.	10 W. 10 W.	Craig Mining Company, F. A. Hebbard et al., Dedrick, lessees	4,200	100	R. XIV, p. 887; U. S. G. S. Bull. 540, p. 78.
*Daisy	5	33 N.	8 W.	H. S. Blakemore, J. A. and E. L. Yates, M. A. Tanner, Box 547, Wilmington	1,960	16	R. XIII, p. 443.
Democrat Group	12, 13	33 N.	10 W.	R. H. Junkans, C. J. Hanna, D. E. Ryan, Weaverville	2,350	243	
Dixie Queen	14, 23	32 N.	9 W.	Morris Brothers, Indian Creek, via Douglas City	2,700	20	R. XIV, p. 887.
Dorleska	15, 16 21	38 N. 37 N.	9 W. 9 W.	Carr and Kingsbury, Carrville	6,550	480	R. VIII, p. 643; X, p. 710; XI, p. 482; XIII, pp. 446, 454; XIV, pp. 887-88; XVIII, p. 207; Pre. Rep. No. 8, p. 18.
Enterprise	4, 5	35 N.	11 W.	W. R. Bigelow, Weaverville	2,100	160	R. XIV, p. 888.
Eureka	33	35 N.	10 W.	Maple Creek Mining Company, Weaverville	4,500	120	R. XIII, p. 446.
Excelsior	9	31 N.	8 W.	Harris and Colegrave	5,560	80	R. X, p. 715; XIII, p. 446; XIV, p. 888.
Excelsior	5, 8	37 N.	12 W.		4,800		
Fairview	3, 10, 11	34 N.	8 W.	Fairview Mining Company, 216 Pine St., San Francisco	2,000	832	R. XIV, p. 888; U. S. G. S. Bull. 540, pp. 75-76.
Fields-Meckel	un surveyed			Dr. D. B. Fields, A. C. Meckel et al., Weaverville	5,900	171	
Five Pines	19, 20, 29	35 N.	7 W.	Lester, Lewis and Elbert Van Ness, 3551 Wilson Ave., Oakland	2,100	183	R. XIV, p. 889; XVIII, p. 355; Pre. Rep. No. 8, p. 18; U. S. G. S. Bull. 540, pp. 73-74.
*Forget Me Not	8, 9	37 N.	7 W.	Mary J. Carr, Carrville	3,500	40	R. XIII, p. 446; XIV, p. 889.
*Foster Group	4, 9, 16	31 N.	8 W.	C. F. Foster Company, Corning	5,000	125	R. XIII, p. 447; XIV, p. 889.
Fountain Head	4	34 N.	11 W.	R. Ellison	3,000	40	R. XIV, p. 889.
Four Point	32	35 N.	10 W.	H. C. Stofor et al., Helena	5,200	40	R. XIV, p. 889.
Gifford	3	33 N.	8 W.	J. F. Gifford, Lewiston	3,050	70	R. XVIII, p. 497.

*Indicates property patented or surveyed for patent, according to county records.

1. Ownership shown is for the most part that in county tax records for 1924-25; but in some cases is taken from former reports, or from recent field notes, in order to show last known person claiming ownership.

TABLE OF QUARTZ MINES AND PROSPECTS, TRINITY COUNTY—Continued.

Name of mine	Location			Owner's name, address	Elevation, feet	Area, acres	Bibliography
	Sec.	Twp.	Range				
Globe Cons.	15, 16, 21	35 N.	10 W.	F. K. Reed, Lewiston.	5,500	200	R. X, pp. 711-12; XI, p. 483; XII, pp. 309-10; 310; XIII, pp. 432, 442, 447; XIV, pp. 889-91; XVII, p. 540; U. S. G. S. Bull. 540, pp. 76-78.
Golden Chest	9	35 N.	11 W.	Boyce et al., J. L. Johnston, Helena.	3,300	40	R. VIII, p. 641; X, p. 711; XIII, p. 447; XIV, p. 891.
Golden Jubilee.	4	37 N.	8 W.	McCormick-Saeltzer Company, Redding.	3,090	180	R. XIV, p. 891; XVII, p. 540; Pre. Rep. No. 8, p. 18; U. S. G. S. Bull. 530 D, p. 27.
Golden Star.	2	33 N.	10 W.	B. R. Brown et al., Weaverville.		40	R. XII, p. 311; XIII, p. 447; XVIII, p. 298.
Gold Leaf							
Graig.	4	34 N.	11 W.	Wm., John and James Meredith et al.		48	R. XIII, p. 448; XIV, p. 892.
Hardtaek.	6	37 N.	12 W.	T. J. Ladd.	4,700	40	U. S. G. S. Bull. 530 D, p. 35.
Hardscrabble.	15	38 N.	9 W.	John Keating and Ann Edwards, c/o Scott Valley Bank, Etna Mills.	6,000	80	R. XIII, p. 448; XIV, p. 892.
Hard Times.	6	37 N.	12 W.	E. C. Miller.	4,400	60	R. XIV, p. 892; XVIII, p. 600.
Hayfork.	18	31 N.	11 W.	Dr. C. A. Mueller, Redding.	3,400	100	R. XIII, p. 449; XIV, p. 892; U. S. G. S. Bull. 530 D, p. 17.
Headlight.	20, 21	37 N.	7 W.	Trinity Gold Mining and Reduction Company, 311 California St., San Francisco.	3,500	424	R. XIII, p. 447.
Headstrom Group.	9, 16	37 N.	7 W.	C. L. Headstrom, Carville.		114	
Henry Clay.	11	33 N.	8 W.	Louise M. Smith, 1821 Lyon St., San Francisco.			
Hunter.				J. P. Hennessy.	2,700	20	R. XIII, p. 447.
Index.	28	37 N.	7 E.	John and J. E. Larsen, Sawyers Bar.	4,500	40	R. XIII, p. 450; XIV, p. 893.
Iron Dyke.	18	37 N.	7 W.	Mrs. Mary J. Carr, Carville.		160	Pre. Rep. No. 8, p. 18.
Isabel.	32	35 N.	10 W.	T. E. Martin.		100	U. S. G. S. Bull. 530 D, p. 24.
Jacoby.		33 N.	9 W.	Goodyear and Richards.	5,600	60	R. XIV, p. 893.
Jerusalem.	9	31 N.	8 W.	J. T. Lockhard.	2,950	80	R. XIV, pp. 893-94.
*Keno.	19	35 N.	7 W.	Nora V., C. W. and A. L. Thresher, O. P. Ormsby, B. F. Rogers, Gridley.	5,350	80	R. XIII, p. 450; XIV, p. 894.
Lapman.	12	33 N.	8 W.	Calumet-Michigan Mining Company, Detroit, Michigan.		227	
Last Chance.	2	33 N.	8 W.	S. T. Dean and J. Kirkpatrick, Shasta.	3,500	60	R. XIV, p. 894.
					3,500	20	R. XIV, p. 894.

Laurel.....	14	32 N.	9 W.	J. Walter Phillips, Lewiston	2,500	63	R. XIV, p. 894; XVII, p. 541.
Layman.....	29	32 N.	11 W.	T. A., C., and A. Layman and Benjamin Murphy, Hayfork	3,000	180	R. XIV, p. 894; XVIII, pp. 207, 600.
Lila.....	12	33 N.	8 W.	T. E. Thurner and Estate T. Gruss, Weed	3,700	17	R. XVII, p. 540
Maple.....	1	34 N.	11 W.	Frank Gallagher, West Point, P. O. Lewiston.	3,500	20	R. XII, p. 312; XIII, p. 455; XIV, p. 894.
May Blossom.....	16	34 N.	8 W.	Joseph and George Kapusta, Lewiston	2,500	40	R. XVII, p. 540.
McClaren Group.....	10	35 N.	11 W.	W. J. McClaren, Helena	2,650	60	R. XIII, p. 456; XIV, p. 893.
Medoc.....	31	9 N.	7 E.	G. W. Healey	4,850	20	
Monarch.....	18	36 N.	9 W.	J. B. Morrison, R. H. Bailey and J. T. Putney, Los Angeles		160	
*Montezuma.....	12, 13	33 N.	8 W.	Niagara Summit Mining Company, c/o W. D. Tillotson, Redding		21	
*Morning Star.....	31	38 N.	9 W.	Maud B. Decker, Box 236, Madison Square Station, New York		15	
*Morning Star.....	3	34 N.	11 W.	Jos. Walters, 224 Brunette St., New Westminster, B. C.		15	
Mountain Boomer.....	5	37 N.	12 W.	Bobs Farm Mining Company, Sacramento	5,000	100	R. X, p. 715; XIV, p. 895; Bull. 92, p. 93.
Nely Thomas.....	7	37 N.	9 W.	Nely Thomas, Coffee P. O.		105	
*New Blue Jay Mining Co.....	13	37 N.	8 W.	New Blue Jay Mining Company, 3320 Geary St., San Francisco	2,700	93	R. XIV, p. 885; XVII, p. 541; U. S. G. S. Bull. 530 D.
Nonpareil.....	9	37 N.	7 W.	Strode Brothers	2,600	40	R. XIV, p. 895.
North Star.....	32	35	11 W.	Estate of R. A. Skinner, Weaverville	2,200	80	R. VIII, p. 642; X, p. 710; XI, p. 482; XIII, p. 458; XIV, p. 895.
Oriole.....	22	32 N.	9 W.	A. L. Paulsen	2,750	40	R. XIV, p. 896
Ozark.....	4, 9	34 N.	11 W.	D. G. Reid	2,200	40	R. XI, p. 482; XIII, p. 459; XIV, p. 896.
Phillips Group.....	14	32 N.	9 W.	J. W. Phillips, Lewiston (See also Laurel)	2,000	63	R. XVII, p. 541.
*Pound Cake.....	8, 9	31 N.	8 W.	H. E. Cotton; Ada M. Ellery, 5915 Claremont Ave., Oakland; S. M. Gibson, Weaverville		16	
Quincy.....	22	7 N.	13 W.	Larsen Brothers, Sawyers Bar	5,000		
Rainbow.....	32	32 N.	8 W.	D. C. Dedrick, Douglas City	2,260	160	R. XIV, p. 896.
Raistoun.....	32	35 N.	10 W.	Trinity County Bank	3,000	40	
Ray.....	12	33 N.	8 W.	Danners and Hollensworth	4,500	40	R. XIV, p. 897.
Readjuster.....	33, 34	34 N.	8 W.	William Richards, Lewiston	2,400	80	R. XIII, p. 460; XIV, p. 897.
Rebel.....	31	29 N.	12 W.	Jack Hoffman, Forest Glen		25	R. XVIII, p. 92.

*Industries property patented or surveyed for patent, according to county records.

1. Ownerships shown is for the most part that in county tax records for 1924-25, but in some cases is taken from former reports, or from recent field notes, in order to show last known person claiming ownership.

TABLE OF QUARTZ MINES AND PROSPECTS, TRINITY COUNTY—Continued.

Name of mine	Location			Owner's name, address	Elevation, feet	Area, acres	Bibliography
	Sec.	Twp.	Range				
Red Bluff.....				Chas. W. Kidder et al., 607 Chestnut St., Redding.....		20	
Reindeer.....	3	37 N.	8 W.	Wagner Mining Company, Berkeley.....	2,900	60	R. XIII, p. 461; XIV, p. 897.
Ridgeway.....	6 31	37— 38 N.	12 W. 12 W.	Ridgeway Mining Company, Weaverville.....	4,750	80	R. X, p. 715; XIII, p. 461; XIV, p. 897.
San Miguel et al. Sherwood Group.....	32	8 N.	8 E.	Paul Potillo, Weaverville.....	4,450	60	R. XVII, p. 542.
*Shoo Fly.....	11	33 N.	8 W.	James W. and John H. Bartlett, Denny.....		80	R. X, p. 715; XIII, p. 462; XVII, p. 542.
Silver Grey.....	33	35 N.	10 W.	Thos. McDonald, A. A. Skinner, W. P. Sargeant and L. S. Smith, French Gulch.....	5,200	20	R. XII, p. 313; XIII, p. 462; XIV, p. 897.
Smith.....	19, 30, 31	36 N.	9 W.	R. L. Carter et al.....	3,900	274	R. XI, p. 483; XIII, p. 462; XIV, p. 898.
Smith Cromwell Spratt and Ingram.....	2	32 N.	19 W.	Paulson and Blake.....			R. XVII, p. 542.
*Star of the East et al.....	13	33 N.	8 W.	S. H. Parkhurst.....			
Strode.....	8, 9	37 N.	7 W.	Dr. C. W. Spratt and Jeff Ingram, Weaver- ville.....	3,700	70	R. XIV, p. 898.
				M. F. Bacon, J. M. Griffith, H. R. Brown, D. M. Sinclair, 1048 Armada Drive, Pasadena.....	2,600	280	R. XII, p. 313; XIII, pp. 458-59; XIV, p. 896; XVIII, pp. 207, 257, 600; XX, p. 182; U. S. G. S. Bull. 530 D.
				Strode Mines Company, 626 Fourth Ave., Milwaukee, Wisconsin.....			R. XIV, p. 898.
Sunny Slope. Supplanter.....		34 N. 7 N.	8 W. 13 W.	Sunny Slope Mines Company, French Gulch. J. and G. Foutes.....	2,600		R. XIV, p. 898.
Thorne.....	23			See Star of the East.....			R. XIV, p. 898.
Tom Morton Cons. et al.....	20, 28, 32	37 N.	6 W.	J. J. Daugherty et al., 151 Clark Building, Canton, Ohio.....			R. XIV, p. 898.
Toughnut.....	6	37 N.	12 W.	Tough Nut Company, Denny P.O.....	4,500	304	R. X, p. 715; XIII, p. 464; XIV, p. 898.
Triangle. Trinity Mohawk.....	11	33 N. 34 N.	8 W. 8 W.	J. Hollingsworth.....	3,600	40	R. XIV, p. 898.
				J. H. King, Redding or French Gulch.....	3,880	280	R. XVIII, p. 498.

*True Blue.....	20	37 N.	7 W.	Gustave La Blanc.....	3,700	12	R. XIV, p. 900; U. S. G. S. Bull. 530 D.
*True Fissure.....	15	35 N.	10 W.	Bank of Tehama.....	-----	40	R. XIV, p. 900.
Uncle Sam.....	5	8-	8 E.	J. Cullich.....	4,500	80	R. X, p. 715; XIII, p. 465; XIV p. 900.
*Van Ness Group.....	32	9 N.	8 E.	See Five Pines.	-----	-----	-----
*Venecia.....	3	33 N.	8 W.	Charles, H. W., F. R. and A. E. Paulsen, Lewiston.....	-----	230	R. XIV, p. 900; XVIII, p. 207, 497.
Wagner.....	34	38 N.	8 W.	P. A. Wagner et al., Coffee.....	-----	60	U. S. G. S. Bull. 530 D, p. 28.
Watson Group.....	25	28 N.	11 W.	J. R. Watson, Knob.....	-----	40	R. XIV, p. 900.
White Cloud.....	3	34 N.	8 W.	J. W. Phillips.....	-----	-----	-----
Yellow Aster.....	21, 29	35 N.	11 W.	East Fork Development and Mining Company, Boulder Creek.....	-----	40	R. XIV, pp. 900-01.
Yellow Rose of Texas.....	20	37 N.	9 W.	Reed M. Saeltzer, Redding, and John Boddecker, Coffee.....	6,500	60	-----
Yellowstone.....	29, 32	35 N.	11 W.	W. R. Bigelow, Weaverville.....	3,000	56	R. X, p. 711; XI, p. 482; XII, p. 314; XIII, p. 466.

*Indicates property patented or surveyed for patent, according to county records.

† Ownership shown is for the most part that in county tax records for 1924-25; but in some cases is taken from former reports, or from recent field notes, in order to show last known person claiming ownership.

GOLD PLACER MINES.

The following notes on individual mines and mining operations, together with the preceding introductory matter on the geology of gravel deposits and the table of placer mines and prospects, will, it is believed, give the reader a comprehensive idea of the magnitude of Trinity County's auriferous gravel resources. Because of the plentiful water supply, freedom from restrictions regarding debris disposal, the excellent climate and the presence of good roads, which give access to most of the unworked areas, this county is today probably the most attractive field in the state for the hydraulic miner who does not wish to contend with rival interests for the use of water, nor to be put to the expense of erecting debris restraining dams.

The column headed 'Bibliography' in the table gives references to our publications covering past mining operations. Many of the properties listed in the table have been worked out, but may prove



The Weaverville Basin, Trinity County, looking from La Grange Hill toward Weaverville.

of interest when some question of water rights, dump space or right of way arises. Certain water rights, for example, in the Weaverville district, claimed by companies now idle, are the key to the operation of properties belonging to others. The notes below cover numerous mines not heretofore mentioned in our reports. Due to lack of data regarding the exact location by section, township and range of certain claims in the New River watershed, these have been omitted from the table, and as that district has shown little activity for many years, and recent work has been on a very small scale, the reader is referred to our Bulletin No. 92, pages 92 and 93, where mention is made of placer deposits in that region. With this exception, the report is intended to serve as a complete index of the county's placers.

Beaudry (Bazet) Mine at old Minersville promised to be active on a large scale as a hydraulic mine this season, but litigation with Nugget Bar Placers over water rights has intervened to delay work. The

property had been idle for a long time previously on account of litigation. In the past year considerable work has been done in refitting it.

Brizard Ranch (Hawkins Bar) contains 340 acres, in part covered by high bench gravel, on the north side of Trinity River five miles upstream from Salyer P. O. at Hawkins Bar. No mining is being done now. At the ranch buildings the gravel is exposed without overburden except a light soil layer. The Irving and Oro Corono properties, containing parts of the same bench gravel deposits, adjoin on the west.

Camzo Mine is a 20-acre placer claim on the east side of the South Fork of Trinity River, $2\frac{1}{2}$ miles from Salyer P. O. The owners, F. M. Tyler, R. P. and E. K. Zoller, have been working with a small centrifugal pump and gasoline engine, pumping the shallow gravel from a small bar into the sluices and have reported good returns.

Costa Placer Mine is on Rush Creek near the Weaverville-Minersville road, about eight miles north of Weaverville. The owners operate it as a hydraulic mine using water from Rush Creek and one giant. The present water supply is small and the season short, but more water is claimed than is being used, and could be brought in by ditch.

The deposit is the gravel along Rush Creek, which has eroded the old Tertiary high channel on Buckeye plateau and reconcentrated the gold sufficiently to make payable gravel. It is only a short distance above the present stream. Besides this property of 40 acres which is partly devoted to farming, the same owners have other undeveloped property nearby.

Dannenbrink Group of placer mining claims along Canyon Creek in the vicinity of Dedrick were under lease and option in 1923 and 1924 to Pittsburg-Comstock Mines Company, whose operations were described in our report of September, 1923, since which work ceased.

Elbert Nickerson Placer is a 20-acre drift mine on main Coffee Creek seven miles upstream from Coffee P. O., the last $4\frac{1}{2}$ miles being trail. Nickerson is working through a tunnel and making a small production.

Fowler Placer Mine is on Coffee Creek $2\frac{3}{4}$ miles by road upstream from Coffee P. O. This 20-acre claim has been worked at intervals for 40 years. F. A. Fowler has lately sunk a flat incline 150 feet long giving a depth of 11 feet below the present stream and has run about 100 feet of prospect drifts. A little gold is produced. There are a small hoist and pump, operated by water power.

George Zinn has a small hydraulic mine on the South Fork of Coffee Creek 13 miles west of Coffee P. O. Snow water is used for washing in spring as the water supply is limited.

Hammer and Kahlke Group (*South Fork Gold and Platinum Mining Company*). This property comprises 895 acres, covering bench and bar deposits along the main Trinity River and the South Fork, and extends for seven-eighths mile along the main stream.

The property was described in detail by the writer in our Bulletin 85.¹ Since that report was written, very little has been done to develop the claims. The owners have been unable to finance the installation of

¹ Logan, C. A., Cal. State Min. Bur. Bull. 85, pp. 86-88.

an adequate water system and have continued work on a very limited scale, as described in the following notes, which are taken from the bulletin mentioned:

"The complete set of gravel covered benches appear on the Hammer property, of which P. P. Hammer of Salyer is principal owner. These holdings comprise 895 acres lying between the main Trinity and its South Fork, with a length of seven-eighths mile up the main stream. The highest or sixth bench, 1000 feet above the river, is unprospected, but there is probably one-half mile of it here. The fifth bench is 841 feet above the water and has been traced for about one mile. It has been mined a little; about one-fourth acre has been hydraulicked by Mr. Hammer and has proven to be good ground. The fourth bench has not been worked or thoroughly prospected. Its edges show occasionally as a bare rocky platform on the road up the South Fork. The third bench has been extensively prospected and has been mined on the Hammer property and on the adjoining properties lying on the east bank of the South Fork. This channel has a length of three-fourths mile and has proven to be productive ground. The gravel is 47 to 50 feet deep with no overburden. The floor of this bench is about 450 feet (aneroid) above the river. The bench is prominently developed clear across the area between the two branches of the river. The second bench has been tested by shafts and tunnels and found to carry from 8¢ to 20¢ a cubic yard. This bench passes under the house of an adjoining landowner, who contested the mineral character of the land. The suit brought out evidence showing that the entire Hammer holdings are mineral land. Some samples from the second bench went as high as \$3 a cubic yard. This bench has been mined in a small way on the opposite side of the river from the Martin house, and yielded satisfactorily. The first, or lowest bench, has not been mined on this property, but higher upstream has been proven productive. This bench is well developed around the mouth of the South Fork, where the present stream flows in a steep canon cut in the rocks to a depth of 60 to 70 feet below the first bench. These six terraces are thought to represent the entire series of stages of the downcutting Quaternary Trinity River. Not all of them, probably, occur so conveniently situated for observation anywhere else on the river, although as many as three or four can be seen at places like Junction City.

"As little known as these bench gravels are, they have been mined enough to indicate that they are probably richer in platinum than any other known area of mining ground in the state. The platinum on the Hammer ground is coarser than would be expected so far downstream, and evidently contains a large proportion of osmiridium. As noted above, Hammer is operating two small hydraulic mines on his holdings. One is on the fifth bench, where Dutchman's Gulch cuts through the gravel. One-fourth acre of ground has been mined here, which Hammer says has yielded \$6,000 and has given as much as four ounces of platinum for \$1,000 in gold. In one 50-hour run with a 6-inch pipe and 3-inch nozzle, nearly one ounce of platinum was saved. The gold is flat, ranging around the size of wheat. Platinum flakes the size of two pinheads are common, and both gold and platinum are clean and bright. Nearly 15 ounces of platinum are said to have been produced from this ground. The very high proportion of the platinum to the gold can be realized when it is remembered that 15 ounces represent the average yearly production of platinum from two California dredgers handling from 200,000 to 240,000 cubic yards a month.

"On the South Fork, possibly a mile upstream from the mouth, Hammer has opened a mine in the gravel of the third bench and has found ground which has yielded well. The bedrock is slate. Where now working, the gravel is 30 feet deep, but increases to 47 feet nearby. There are two strata of gravel in the bank, colored red and blue; the latter is the richer, and has shown a value of 37¢ a cubic yard as against 18¢ for the red phase, where they were prospected by shaft. The recovery from the ground actually mined has exceeded these prospects as Mr. Hammer claims to have realized over 60¢ a yard. The gold is in flakes of medium size, seldom smaller than No. 2. Platinum colors can be easily panned on the bedrock. They range from very fine to No. 2 size. The amount of ground moved here has been small, because very little water is available.

"Failure to work these holdings on a larger scale has been due to lack of water, and to adverse claims of agriculturists. * * * The problem of water supply has been the chief difficulty. There are no streams nearby high enough to put water on the fifth bench. The only water now available there is the run off during the winter rains. Two miles of ditches have been dug to encircle the hill 80 feet above this bench, and these ditches serve as reservoirs which permit washing with one giant during wet weather. It is estimated that a water supply sufficient for six months steady piping anywhere on the 895 acres could be obtained from Eltapom Creek, a branch of Hayfork, by building 18 miles of ditch and flume. For a full year's supply it is thought that it would be necessary to tap the Hayfork at a distance of 34 miles. A siphon from Campbell Creek would furnish a supply for the third bench gravel. * * * The gravel is loose and easily worked and there is ample grade with plenty of space for dump."

Henninger Brothers Placer adjoins *Elbert Nickerson Placer* upstream. They are ground sluicing.

Hook and Ladder Mine is adjacent to the town of *Weaverville* on the north. It has been worked intermittently in a small way as a hydraulic mine for many years and is one of the few remaining active mines in the district. The deposit is part of that filling the *Weaver-*

ville Basin, composed of gravel washed down by recent streams from the higher and older deposits. The bank ranges from 20 to 30 feet in height.

During the season of 1924-25 about one acre in area was hydraulicked, giving a reported return of \$7,000. This is about the same rate of yield as made previous to the war, but the costs, which totaled about \$2,200 a season at that time, have greatly increased. Water is taken from the La Grange Mining Company's Rush Creek ditch through a 12-inch pipe line, and three giants are used, one for the bank, one at the head of sluice and one at the foot of sluice, on account of the lack of grade and dump.

This work was on the low ground of the Rule Channel. There is another and slightly higher gravel area on the property, and an acre or less of this has been worked, but bedrock has not been reached. Most of the Rule Channel on this property has been worked.

Howard and Campbell Placer Mine contains 35 acres, at Big Bar but on the north side of the river. On the New Year Claim there are three benches of gravel of which the lower two have been worked by the owners during the past season. The bank is 40 feet high, and rocky on top, with sand and finer gravel below, the lower 12 feet next bedrock carrying pay, with coarse gold. This claim covers a length of 600 feet along the course of channel, and there are in all only a few acres of gravel.

Water is taken from Manzanita Creek through three-fourths mile of ditch, giving 225 feet fall, with sufficient water in a good season to fill a 6-inch nozzle and permit mining from December to May. A dam 12 by 50 feet would give a better water supply by permitting storage. The owners also have one-half interest in the water of Price Creek. The reported return from the small area worked indicates good gravel, and it should be a paying property for two men for a few seasons.

Humboldt Placer Mining Company's holdings comprise 4800 acres of locations, on Buckeye Plateau between Rush Creek and Stuarts Fork, extending for several miles west and southwest of Minersville. The road up Rush Creek, after turning east toward Minersville, traverses this gravel area for several miles at an elevation of around 3000 feet.

This gravel is part of the immense accumulation of Tertiary gravel of the so-called Weaverville Basin, upon the Sherwood peneplain, and similar geologically to the other high gravel deposits previously mentioned. The company has done little toward developing their claims. A small giant and 300 feet of 8-inch pipe have been used for prospecting some of the gravel in the gulches. They have had an application before the State Division of Water Rights for two years, asking to appropriate water from Stuart Fork, but the present status of this application is not known, although it is possible that others have prior rights to most of this water.

Diller¹ wrote as follows regarding this region:

"Between Stuarts Fork and Rush Creek there is a great body of fragmental deposits made up in part of more or less angular material that suggests glacial origin but including much gravel that is well rounded by water. The main belt crossing the Buckeye Plateau lies west of Buckeye Creek. It has a width apparently

¹ Diller, J. S., Bull. U. S. Geol. Survey, No. 540, p. 18.

of nearly three miles and a depth where greatest of more than 800 feet. Three shafts from 40 to 195 feet in depth have been sunk on the top portion of this deposit to test it for gold. Little if any gold is said to have been found and no actual mining tests resulted.

"The surface of the Buckeye Plateau is generally reddish soil to a depth of 15 feet or more, passing downward into a sandy argillaceous mass in which the forms of rounded to subangular fragments and some boulders may be seen and a few well-rounded solid pebbles are preserved. On the plateau surface there are for the most part only a few scattered pebbles with here and there a small, well-rounded boulder, but on the slopes of the ravines cut by branches of Buckeye Creek, as well as on the plateau borders facing Rush Creek and Stuart Fork, well-rounded gravel is in many places abundant and extensive. Buckeye Creek drains the great body of fragmental material that forms the Buckeye Plateau. * * *

"Rush Creek, whose present stream bed affords some good placers, cuts a deep narrow valley directly across the old channel but does not reach the bottom."

At the *Indian Creek* and *Panwocket* properties in Indian Creek district four miles from Douglas City, little work has been done since the war, but in 1925 a ditch was being extended an additional mile and a half to put water for hydraulicking on the south side of the Panwocket ground, and it was hoped this could be completed in time to permit some mining the present season. This group covers 1741 acres, containing considerable unworked ground. The owner, Dr. D. B. Fields, is developing it and plans ultimately to extend the ditch to Douglas City, where he has 820 acres more, containing good hydraulic mining ground. Equipment includes 3200 feet of iron pipe ranging in size from 13 to 22 inches, two giants, and two houses.

Ivy Gulch Placer Mine covers a frontage of one-fourth mile on the south side of Trinity River, near Big Bar Creek between Helena and Big Bar. The gravel bank, 15 to 40 feet deep, is on one of the later terraces not far from the present stream. The deposit is worked by hydraulicking on a small scale, using one giant supplied with water under 70 feet fall from Big Bar Creek.

J. A. Mac Donald of Coffee P. O. has a drift mining claim on Coffee Creek, one-fourth mile northwest of the post office. This has been opened by a shaft and a little gravel was washed and is said to have prospected, but the claim was idle in October, 1925. The gravel is heavy, free wash. The same owner has a placer claim on Coffee Creek $2\frac{1}{2}$ miles west of Coffee P. O. on which he was beginning work in 1925. Water is available in Sugar Pine Creek for work on a small scale.

The *Jacob Brothers Estates* own many hydraulic mining claims in Junction City district, and among these is some of the best remaining hydraulic gravel in the region. On account of the fact that the former owners did not control enough water to operate the properties on a large scale, and were unable to secure a supply from nearby owners, they were able to work only in a small way, with about 500 miner's inches of water under low head and for a short season. Consequently only a small part of the available acreage has been worked. During the past ten years very little work has been done.

The deposit consists of terrace gravel at former levels of Trinity River on the west side of the stream two miles below Junction City. The gravel is 15 to 30 feet deep and overlain by 40 feet or more of red clay and loam. Small water rights are owned in Connor Creek and nearby gulches.

The latest work has been done the past few seasons, subsequent to the death of the last owner. The claims were leased and water for operation was leased from adjoining owners, and some short runs made.

Koon Ranch is on the South Fork of Trinity River, about two miles above its mouth. There are 50 to 60 acres of gravel here, averaging 25 feet deep. The bedrock is slate, and the gravel is medium to fine in size, and blue in color. A test run by J. A. Koon several years ago indicated a gold content of about $7\frac{1}{2}$ cents a cubic yard, and nearly one-half as much platinum metals by weight as there was gold.

La Grange Mine deserves special attention because of the magnitude of the operations which were carried on there and the great amount of valuable information regarding the methods and costs of hydraulic mining made available by this work. This mine was located in 1851 as the Ward Placer, and incorporated in 1874, and worked by various companies until 1918. The acreage of holdings and scale of operations were increased under the several operators. The holdings of the company comprise several thousand acres in the vicinity of Weaverville, and between that place and Junction City, and only a relatively small area has been worked although the operations were on a larger scale than at any other hydraulic mine worked in recent years.

The part which was mined lies on the west side of the ridge, four miles west of Weaverville on the road to Junction City, and drainage is through Oregon Gulch into Trinity River. The gravel is a portion of the channel filling of the Tertiary Trinity River, covered by an immense accumulation of very low grade or nearly barren overburden. As mentioned by Mac Donald¹ and Diller² the gravel lies in a trough formed between a fault plane on schist on the northwest and slate and limestone bedrock on the southeast. The upper portion of deposit shows strata dipping toward the fault plane. The bedrock on the fault plane, which forms the present north rim, is a fault gouge of crushed schist and slate, and very soft. The best pay was found in a layer of blue gravel and was about 15 feet thick. This is heavy, rocky and well washed and is said to have paid up to \$2 a cubic yard. Above it, and separated from it by a layer of clay, is about an equal thickness of red gravel, and a layer of cement gravel. This series of strata carry the pay and lie on the south rim of slate and extend two-thirds the distance across the channel. Covering the pay gravel, and extending across the north rim, the low grade free-wash gravel has a depth as great as 600 feet. The wash in the mine contains a variety of rocks not found in the immediate vicinity and there are many heavy boulders.

The water installation included a ditch and flume 29 miles long, of which 11 miles were flume, of truncated V-shape, nine feet wide on top, two feet wide at the bottom and five feet deep. The flume was built in 1895 at a contract price of \$25 per thousand board feet in the flume. Its capacity was 3500 miner's inches and the grade was 10 feet per mile. This flume is now down, and could not be replaced at anything near the above cost. The main water supply was from Stuarts Fork, Rush Creek and Weaver Creek, but the water of several other streams was picked up on the way to the mine, and delivered to the reservoir on the ridge above the working pit.

For bank piping, it is stated that 5500 miner's inches of water, under 650 feet fall, was used in two giants. The bedrock was so soft that it was easily undercut by the giants, permitting the immense bank to cave, thus facilitating work. However, in later years the bluish clay

¹ Mac Donald, D. F., Bull. U. S. Geol. Survey, No. 430, p. 52.

² Diller, J. F., Bull. U. S. Geol. Survey, No. 470, p. 16.

on bedrock kept moving into the pit and up, on account of the weight above it, and they were compelled to keep piping off this barren material from the north in order to keep the flumes open. From 1905 to 1907 work on the south rim is said to have paid well, but the French company in later years worked principally in the sliding gouge and low grade overburden. The two bank giants were not moved for six years between 1912 and 1918, as the bank kept moving in, and the lower layers of better pay gravel were scarcely reached in this time. The yield in good years was about nine cents a cubic yard, but in later work went as low as $2\frac{1}{2}$ cents a yard. The cost of operation in the last few years work kept increasing, and yield decreased until the two were about equal. The annual cost of operation was \$80,000 to \$110,000.

Three thousand feet of sluices, four by six feet in cross section were used, on a grade of seven inches in 12 feet in the upper section and



General view of La Grange Hydraulic Mine, near Weaverville.

eight inches in the lower. Steel rails were used for riffles, and the sides of the boxes were lined with the bases of the rails which had previously had the tops worn off while being used as riffles. Success in saving very finely divided gold was claimed, and was ascribed to the eddying action set up by the shape of the rails. The curve of settlement for gold of different sizes was studied here. The pieces larger than 10-mesh, which comprised over one-half the total, stopped principally in boxes 11, 5, 12 and 13, the first named receiving more than the others, and the amount decreasing rapidly from box 13 onward. From 10- to 50-mesh gold stopped mostly on the way to box 12 and that box marked the maximum recovery of these sizes. Most of the gold finer than 50-mesh stopped in the first 13 boxes. The gold of all sizes which passed box 22 did not seem to settle so rapidly beyond it, but spread out over the remaining boxes. When mining was suspended in 1918, operations had reached nearly to the top of the

ridge (elevation 3400 feet) and several changes would have been needed in order to continue mining the large remaining gravel areas owned by the company. The acreage held by the company is for the most part along the course of the Tertiary Trinity River, at elevations of from 2500 to 3000 feet, and below their own system of ditches.



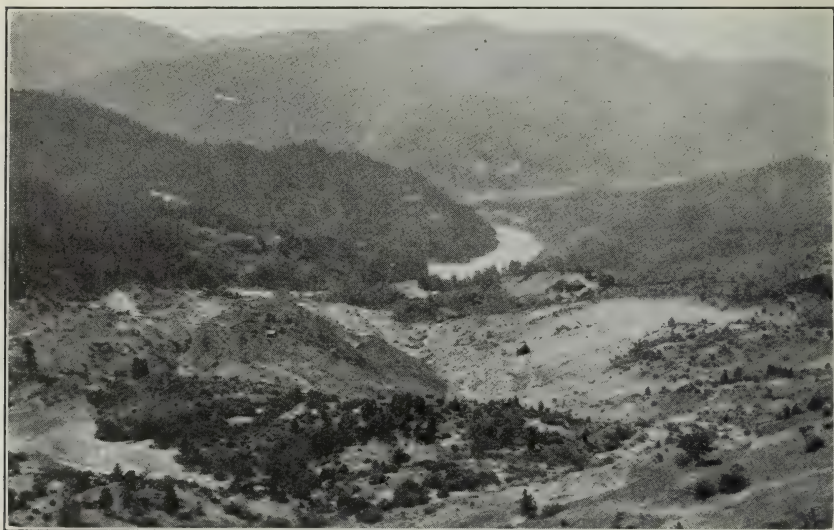
La Grange Hydraulic Mine showing trough and rims of channel.

Among the promising and only slightly prospected areas held by them, is the *Musser Hill* property, along the ridge between Browns Creek and East Weaver Creek, two miles northeast of Weaverville. This covers parts of five sections and perhaps a mile and a half along the channel. It has been prospected by a few surface cuts and two adits in gravel, and this work is reported to have indicated a gold content of from

four to nine cents a cubic yard. If the old main ditch were put in repair and tapped somewhere along the upper course of Rush Creek, at about the 3500-foot contour, a few miles of new ditch would give ample water and pressure for working this gravel, which lies mostly between 2500 and 3000 feet in elevation.

The La Grange property under the different owners is estimated by B. R. Brown to have produced about \$8,000,000 and it contains a larger unworked area than that already mined.

Lorenz Brothers Mine is the principal operating hydraulic mine of the Weaverville district. These owners have operated each season for many years past. The gravel is along Weaver Creek, south of Weaverville, and is mostly fine and free washing. It is the result of the erosion and reconcentration of the older gravel of the higher ridges, washed down and deposited by the recent and modern streams. This stream has also been the sluiceway for the tailings from many of the



Another view of La Grange Mine, looking southwest down Oregon Gulch. This shows the schist bedrock fault plane on northwest (light colored, right half) and slate on southeast rim. Oregon Gulch is filled to a great depth with the mine tailings.

old gravel mines formerly operated upstream near Weaverville. Part of the ground also contains older wash, above the present stream, and characterized by coarser boulders and red clay. The geologic history of the Weaverville Basin has been complex and not completely worked out by geologists. For a long time, subsequent to the formation of the high channel deposit of Tertiary Trinity River, that part of the so-called Weaverville Basin immediately surrounding Weaverville was a lake, in which were impounded and preserved vast accumulations of gravel, sand and clay, with lignite and other remains characteristic of such basins. Recent streams flow across this, and have very light grades.

Due to lack of grade, these operators have had to pipe much of the gravel up to the sluice boxes, and also stack tailings with another

giant, three giants in all being used. They use about 3000 inches of water and work about two acres of ground each season of four to five months annually, except in years when there is ample early rainfall. The gravel ranges from 10 to 30 feet deep. The production is said to average \$5,000 or more per acre. There remain perhaps 80 acres to pipe.

The same owners have interests in numerous other hydraulic mines in the county which have not been active in recent seasons.

Montezuma, McGillivray, Mammoth and numerous other hydraulic mining claims, many of which have been worked extensively in years past, contain a total of 1641 acres under the ownership of W. H. Metson, Gerald O'Shay, J. S. Sullivan and others. These cover bench and bar gravels along the west and south side of Trinity River near Connor Creek and Dutch Creek. As mentioned elsewhere, the bench gravels in this section are noted for the numerous large rocks con-



Lorenz Hydraulic Mine, near Weaverville.

tained. Little hydraulicking has been done here in the past 10 years. These claims control five ditches and water rights in Dutch Creek, five in Connor Creek and two in Maxwell Creek, and some work has been done on the nearby Jacob Estates claims, in the past few years, using this water under lease.

Nash Placer Mine (Big Flat, Abrams and Blythe) covers seven miles along the course of South Fork of Coffee Creek including the bed, bars and benches of the stream. The old lower workings are nine miles or more by trail from Coffee P. O. and the ground extends thence to the very headwaters of the stream, in that part of the watershed formerly drained by South Fork of Salmon River. The country rock and accumulations of debris indicate the former existence of glaciers.

The former operations were described in Reports X, XIII and XIV of the State Mineralogist. The property has been idle for many years, since the war, the last active operations having been by Trinity

Hydraulic Gold Mining Company, Ltd., of London. The ground has been partly worked by drifting, and partly by hydraulicking, elevators having been used for some of it. Tunnels and cuts have been run to drain the ground and reach bedrock, as much of it lacks grade, although good pay is claimed to have been taken out over a long period.



Nugget Bar Hydraulic Mine near Minersville.

Dredging has been suggested and in 1921 the ground was leased with this in view, but the project did not materialize.

The equipment includes giants, hydraulic elevators, pipe, old hoisting works, sawmill and buildings. Two ditches take water from the South Fork of Coffee Creek and Abrams Creek, and a total of 3000 miner's inches is available.

Nugget Bar Placers has resumed work the present season on the Van Mater Estate holdings near Minersville. Hydraulicking is going on at this time.

North Fork Mining and Hydroelectric Association of Los Angeles has under lease and option about 300 acres at and near Helena (North Fork). This includes the *Hydraulic Hill*, *Osborne* and *Schlomer* hydraulic mining properties, of which perhaps 150 acres is mining ground, on different terrace levels of the Trinity and its North Fork. This company has plans for water storage in two reservoirs, one on the East Fork of the North Fork of Trinity River nine miles from Helena, the other on the North Fork 18 miles from Helena. It is not known whether this is purely a hydroelectric power project, or if mining will also be carried on, although no actual work looking to a resumption of mining had been undertaken up to the autumn of 1925. The hydraulic mines mentioned have been idle for many years. P. W. Porter of Helena is in charge locally.

Oro Corono Placer (Corona de Oro) is on Trinity River, $4\frac{1}{2}$ miles upstream from Salyer P. O. and near Hawkins Bar. The river flows here at an elevation of about 500 feet, and the mining claims, containing 560 acres, cover the gravel on the series of benches formed in recent and Quaternary times on the north side of the canyon, up to an elevation of 1300 feet or more.

Only a small area has been hydraulicked. Ten years ago Corono de Oro Mining Company brought water from Hawkins Bar Creek and Cedar Creek, a branch of Horse Linto Creek, through 10 miles of ditches and a tunnel 1100 feet long and used a 5-inch giant under 260 feet head for piping one of the lower bench deposits. A supply of 650 miner's inches was available for only a short season, the longest continuous run being only 12 days.¹ It was reported at that time that the gravel yielded 28 cents gold and 4.6 cents platinum group metals per cubic yard. It was believed considerable pay was lost, as both the gold and platinum metals were fine in size (the largest gold nugget being worth \$5), and no undercurrent was used. J. W. Shielkie has been working the property lately under lease.

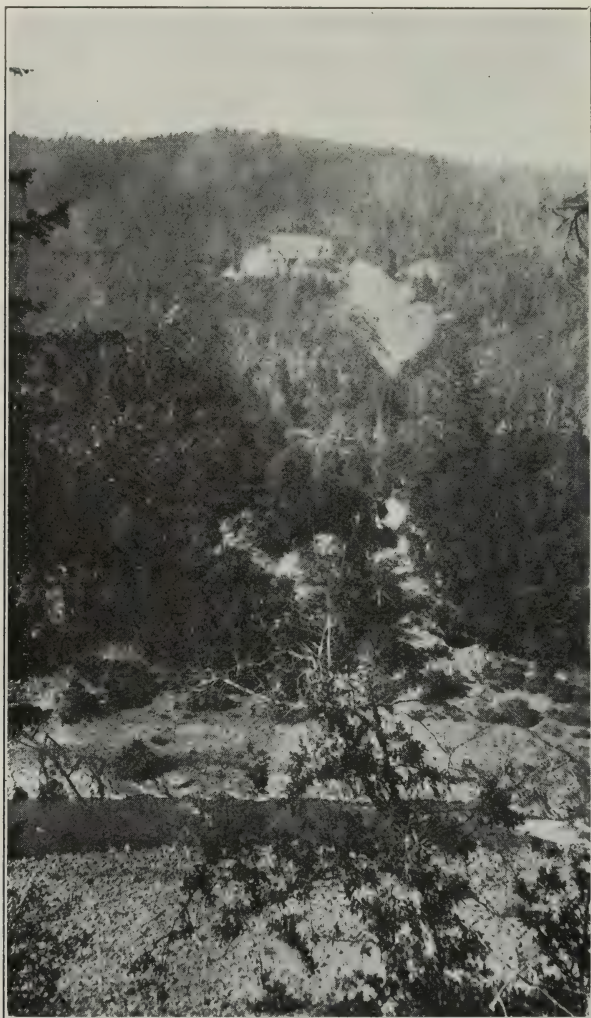
There are five or six separate benches on the claims and the upper ones are covered by heavy red overburden. There are numerous other claims adjoining, and the entire area should be of interest to the hydraulic miner. Mining has been retarded by the scarcity of water nearby, and by the expense that would be involved in bringing it from a distance. There are about 2000 acres of mineral land in this immediate vicinity, consisting of bench and bar deposits at different levels, of which only a small part has been worked.

Patrick Holland's Placer Mine is on the East Fork of Coffee Creek, eight miles from Coffee P. O. of which distance $5\frac{1}{2}$ miles is steep trail. This mine has been worked every season by the present owner, Patrick Holland, for the past 50 years, making it probably the oldest active placer mine in the state. The holdings extend for $3\frac{1}{2}$ miles along the East Fork, beginning one mile above its mouth. The elevation is 4100 to 4500 feet, and the working season extends from the beginning of

¹ Logan, C. A., Cal. State Min. Bur. Bull. 85, pp. 89, 90.

the spring thaw, late in March or early in April, until the first heavy snow, about the first of November.

The present owner has worked three-fourths mile of the creek bed from which he produced \$60,000, and some drifting has been done. Beginning in 1855-56, about 1000 feet more was worked upstream



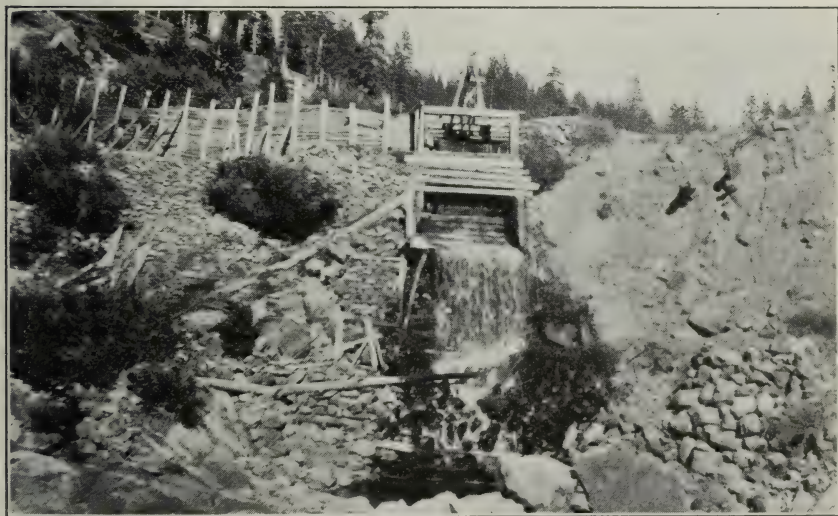
Oro Corono Hydraulic Mine, near Salyer. Trinity River
in foreground.

above the dam, but the output from this is unknown. During his occupancy, Holland estimates a total of about 10 seasons' time has been spent in the 'dead work' of preparing, moving equipment and the like, when no production was made. Usually only two men are employed, and many seasons the owner has worked alone.

The deposit consists of loose and very rocky gravel in the present stream. Where work is going on the canyon is steep and narrow. A derrick is used to stack large rocks, many of which are slabby and not easily moved by water, and some have to be blasted. One ton of dynamite is used each season for blasting. The ground here is 30 feet



Patrick Holland Placer Mine, on East Fork of Coffee Creek, Trinity County.



'Self-shooter' reservoir, with automatic gate, Patrick Holland Placer Mine.

deep, but averages 24 feet deep and 30 feet wide. Heavy rocks in the channel are stacked at the side first.

Water for mining is impounded in a reservoir holding five acre-feet. A 'self-shooter' or self-acting gate 12 feet wide and $14\frac{1}{2}$ feet high discharges every 25 to 30 minutes, releasing a maximum of perhaps

10,000 miner's inches. This carries off gravel and sand, and probably considerable fine gold as well. This process of washing continues from the opening of the season until about August first. With the shooter about a mile above the work, as it now is, only about 10 minutes out of each 30 is available between floods of water to remove large boulders. When the thickness of the gravel in the stream bed is reduced to 2 or 3 feet, and the flow of water is becoming smaller, use of the self-shooter is stopped, and shovelling into the sluice begins. The boxes are 18 inches wide and 1 foot high, on a grade of 6 to 10 inches, and 100 to 150 inches of water are used. From 5000 to 8000 square feet of bedrock are cleaned each season. The gold recovered is mostly coarse. Numerous nuggets of good size have been found. The largest were worth about \$600. The only equipment is a derrick operated by a small gas engine, the sluices and hand tools.

Schlumberger Placer is on the North Fork of Coffee Creek, eight miles from Coffee P. O., five miles being trail. The owner works the claims.

South Fork of Trinity River. Little mining has been done on the South Fork of Trinity River above the region around its mouth, which is described under the Hammer and Koon properties. Big Oak Flat in Sec. 26, T. 6 N., R. 5 E., contains 100 acres of high gravel averaging six cents a cubic yard in gold. Low grade gravel also occurs in Sec. 12., T. 5 N., R. 5 E. *Lynch Brothers* have some claims on the South Fork above the mouth of Grouse Creek but have done no work for the past season. Some work preparatory to hydraulic mining has been going on during 1925 near Auto Rest (Forest Glen) where the road from Peanut to the coast crosses the South Fork. Here the *Peacock Mining Company* of Vallejo, with G. C. Wheeler as manager, has prospected ground and has been putting in ditches and equipment. They claim to have obtained very good prospects.

Hayfork Creek, the main tributary of South Fork, enters it near Hyampom. The Hyampom Valley is a mile wide and over three miles long, and is filled with an accumulation of ancient conglomerate and sandstone, with considerable lignite. This series of beds is of Tertiary age according to Diller.¹ Above this occur deposits of later terrace and stream gravels. There are numerous placer locations along the Hayfork from the mouth up to Hayfork Valley. In this section the stream flows over bedrock, which in places visited is granodiorite, and the gravel accumulations are small and have been worked only by hand. Platinum occurs here with the gold.

Hayfork Valley contains perhaps 10,000 acres of which two-thirds are underlain by gravel, covered by soil, and forming the most extensive area of agricultural land in the county. The lower gravel is of the Tertiary period, preserved by having been faulted into a basin of harder rock.² At one time a busy placer mining region, supporting a large population of white and Chinese miners, the vicinity of Hayfork has shown little mining activity in the last ten years, although numerous placer locations are recorded. Several dredging companies have prospected this valley, but none has ever started operation, due

¹ Diller, J. S., *Bulls. U. S. Geol. Survey*, Nos. 470A, 470B. 540B.

² Diller, J. S., *Bull. U. S. Geol. Survey*, No. 470, p. 21.

probably to geologic conditions, to local sentiment, and to a disinclination to carry on pioneer work in such a remote locality.

Diller estimated the maximum thickness of older gravel and shale here to be over 1000 feet. Some of it is cemented, as exposed in old mines on the north side of the valley. Younger gravel, 5 to 12 feet thick, has been mined a little.

Teal & Perigot Group (including *Gem Placer* or *Scharber Slough*) is on the north side of Trinity River about a mile and a half upstream from Salyer P. O. The Gem Placer has been worked in a small way for many years, using water through one mile of flume and ditch from Quinby and Scharber creeks. Part of the ground is near the present river level and with adjacent land was prospected in 1916 for dredging, but the available area was said to be too small for a large dredge and too deep for a small one. Scarcity of water in recent years has prevented much work. The equipment includes three giants, 4000 feet of pipe, a small sawmill and buildings. The *Crossover Placer*, covering unprospected high bench gravel, adjoins.

Tinsley and Treloar (Fortune Teller) Placer is at Big Bar on the south side of Trinity River. Geo. Tinsley and E. W. Treloar have owned and worked the property for many years and Treloar states the total production has been about \$100,000. Possibly ten acres have been worked, although no measurements or records of yardage are available. No work has been done since 1921.

The deposit is on the second bench above the present river, and bedrock is only 50 feet above the stream, and at 1300 feet elevation. The bank is from 40 to 150 feet high, and increasing on account of the steepness of the hillside. Possibly higher benches of gravel exist, but the principal proved acreage lies between the present pits and Big Bar store and is devoted to farming, being about one-half mile in length and one of the few level areas of arable land in the district. A new bedrock cut is needed to continue operation at the upper pit.

A ditch from Price Creek supplies 600 miner's inches of water, enough for one pipe head under 80 feet pressure.

The property was under option in the autumn of 1925 to C. E. Clark of Richmond but no work was going on.

Union Hill Hydraulic Mine is near Douglas City on one of the higher and older terrace deposits 175 feet above the present river. It was first worked in 1862 but lay idle a long time until bought by the Union Hill Hydraulic Company in 1906. Water was brought in from Grass Valley Creek, and East Weaver Creek, through ditches, flumes and pipe lines for a distance of 15 miles, giving 450 feet fall and sufficient water for about six months work with two 7-inch giants. The property was finally acquired by Trinity Consolidated Hydraulic Mining Company who quit operation in 1914. Since 1922 it has been leased to T. R. Arbuckle, who employs six men in the working season.

TABLE OF PLACER MINES AND PROSPECTS, TRINITY COUNTY.

Name of mine	Location			Owner's name, address	Elevation, feet	Area, acres	Bibliography
	Sec.	Twp.	Range				
*Ackerman Group	19, 30	35 N.	10 W.	John Q. Ackerman, Dedrick		39	
*Alder Gulch	15, 22	33 N.	10 W.	John P. Booth and Chas. Van Damme, 564 Market St., San Francisco		60	R. XIV, pp. 918-19; Bull. 36, p. 104; U. S. G. S. Bull. 540, p. 19.
*Alta Bert	4, 8, 9 et al	36 N.	7 W.	Estabrook Gold Dredging Company, Trinity Center		200	
Andy	3, 9, 10	37 N.	11 W.	Bert Higgins, Helena		90	
Auto	13	34 N.	7 E.	A. H. Jens, Ruth		20	
*Bald Point	33	33 N.	9 W.	P. M. Paulsen	2,200	120	R. XII, p. 313; XIII, p. 459; XIV, p. 901.
*Barthol Jacob	1, 2, 34, 35	33 N.	11 W.	Estates of H. and J. Jacob, c/o F. M. Miller, Weaverville	1,700	390	R. XIV, p. 901.
*Bates and Van Matre	33	34 N.	11 W.	J. M. McCrady, 624 Upas St., San Diego	1,800	20	R. XIII, p. 438; XIV, p. 901.
Battle Peak		34 N.	8 W.	N. L. Hildrick, Copper			R. XVII, p. 543.
Beaudry	28, 29, 32, 33						
*Bed Rock Tunnel	12	35 N.	8 W.	Angele Bazet, 4 Laguna St., San Francisco		3,330	R. XIV, p. 901.
Bell Gulch	29	34 N.	10 W.	L. Heimbürger, Junction City		18	
		33 N.		J. A. Gilzean, Junction City and Geo. O. Laws, Douglas City		40	R. XIV, pp. 901-02.
Big Creek	7, 8	31 N.	11 W.	Big Creek Placer Mining Company, Oakland		58	
*Big Dutchman	1	34 N.	9 W.	J. H. and E. H. Boyce, Minersville	2,300	30	R. XIV, p. 902.
Big East Fork	30, 31	35 N.	10 W.	Cons. with Dannenbrink	2,400	40	R. X, pp. 699-700; XII, p. 307; XIII, p. 439; XIV, p. 902.
Bloss & McClary	5	36 N.	7 W.	Skeys Mining Company, Redding		136	
Blue Gravel	1	31 N.	11 W.	D. E. Shack		40	R. XIV, p. 902.
Blue lib.	13	37 N.	8 W.	Graves and Carter	2,800	20	R. XIV, p. 916.
Blue Lead	6, 31, 36	33 N.	9 W.	T. I. Woodbury	2,500	160	R. XIV, p. 902.
Bonton	26	34 N.	10 W.	W. D. Carr, Lewiston		60	
Bourier Group	4	34 N.	9 W.	Jos. F. Bourier, 4 Laguna St., San Francisco		180	
	28, 33	35 N.	8 W.				
Bower and Matlock		31 N.	11 W.	M. M. Bower and James Matlock, Hayfork		90	R. XIV, p. 902.
Boyd	28	8 N.	8 E.	A. Boyd	3,710	20	R. XIII, p. 440; XIV, p. 916.
Brown's Bar		7 N.	7 W.	Brackett and James Estate	1,950	140	R. XIV, p. 903.
Buckeye	19	37 N.	7 W.	M. H. McIlwaine		40	R. XIV, p. 917.
Burger	12, 13	34 N.	11 W.	J. A. Burger		26	R. XIV, p. 903.
*Cacy et al (Casey)	26, 27	32 N.	9 W.	Dr. D. B. Fields, Weaverville	2,100	160	R. XIV, p. 903.

*Canada Hill.....	4	34 N.	8 W.	P. Burr and N. C. Richardson, Lewiston			
Carr.....	32	33 N.	10 W.	Geo. F. Lewman, Junction City	1,600	80	
*Carr Joseph et al.....	1	32 N.	10 W.	M. C. H. C., and I. Jordan, Douglas City	2,100	34	
Clement.....	29	32 N.	9 W.	C. E. Clement, Douglas City		160	
*Clement and Mule Creek.....	30, 31, 32	35 N.	8 E.	Chas. Boyce, 455 Morse St., San Francisco, and Estate of E. S. Skewis, Minersville	2,200	350	R. XIV, p. 903.
*Chamberlain and Red Hill.....	13, 18	33 N.	8 9 W.	Lawrence Gardella, c/o H. H. Bragdon, Lewiston	1,800	20	R. X, pp. 708-09; Bull. 92, p. 93. R. XVII, p. 543.
Champion.....				C. Bradbury and John Hagleman, Junction City			
Champlain.....	7, 18	33 N.	9 W.	C. Bradbury and Theresa M. McDonald, Junction City		23	
*Chapman and Fisher.....	19 et al.	33 N.	10 W.	E. G. and G. P. Chapman, Junction City	1,600	373	R. X, p. 708; XIII, p. 442; XIV, p. 903.
China Bar.....	17	33 N.	6 W.	G. J. Scannell and S. Sorenson, 529 First National Bank Building, Oakland		40	
*Clayton.....	7, 8	33 N.	8 W.	Samuel Williams, Lewiston		120	
Clover.....	12	37 N.	8 W.	A. M. Daly	2,700	106	
Colby and McIlwaine.....	16, 20, 21	38 N.	9 W.	C. F. Colby and M. H. McIlwaine, Carrville		60	R. XIV, p. 903.
*Constock.....	32	36 N.	7 W.	Fred Giddings, Haina, Hawaii	2,200	40	
Consolidated.....	26	32 N.	9 W.	Estate of F. R. Duarte, D. B. Fields, Henry A. and Wm. Morris, Douglas City		42	
Corono Mining Co's Group.....	17, 18	6 N.	6 E.	Corono Mining Company, c/o Philip Bruce, 690 Fifth St., Eureka		560	R. XIV, p. 904; Bull. 85, pp. 89-90.
Corono de Oro.....				See Corono Mining Company			
*Costa.....	21	34 N.	9 W.	J. P. and Jesse Costa, Weaverville		40	
*Coombs, Wallace and Ingram.....	31	32 N.	9 W.	S. J. Bigelow, Douglas City		140	
*Crofton.....	32, 5	34 N.	9 W.	Anna A. W. Junkans et al., Mill Valley		30	
*Curley.....	1	35 N.	9 W.	W. Leach		99	R. XIV, p. 904.
Daisy.....		31 N.	11 W.	See Hilliard			
Dannenbrink.....	12, 13 et al.	35 N.	10 W.	Geo. A. Grotefend, Redding; D. C., August, Augusta, Henry and Estate of W. F. Dannenbrink; E. C. Edwards and Jo- hanna Mortimer, Junction City	2,000	1,067	R. XIII, p. 444; XIV, pp. 902; 904; 906; 912; XVIII, p. 601; XIX, p. 59.
Democrat.....	11	33 N.	10 W.	Edward Meckel, Weaverville		40	
Democrat Gulch.....	13, 14, 23, 24	33 N.	10 W.	Armentrout Brothers, Weaverville		640	R. XVII, p. 543.

*Indicates property patented or surveyed for patent, according to county records.

1 Ownership shown is for the most part that in county tax records for 1924-25; but in some cases is taken from former reports, or from recent field notes, in order to show last known person claiming ownership.

TABLE OF PLACER MINES AND PROSPECTS, TRINITY COUNTY—Continued.

Name of mine	Location			Owner's name, address	Elevation, feet	Area, acres	Bibliography
	Sec.	Twp.	Range				
*Dock & Kise.....	17	33 N.	8 W.	H. B. and L. M. Lister, 805 Pacific Bldg., San Francisco.		48	R. XIV, p. 904.
Dolly Varden.....	9, 16	33 N.	10 W.	A. A. and F. A. Schaffer, Junction City	2,050	48	
Douglas City.....				Dr. D. B. Fields, Weaverville.		820	
Drinkwater.....	13, 24	31 N.	12 W.	Drinkwater Mining Company, Oakland.		100	R. XIV, p. 904.
Driver.....	15	33 N.	10 W.	G. D. Young	2,900	160	R. XIV, pp. 904-05.
*Dry.....	25	32 N.	9 W.	H. H. and Wm. Morris, Douglas City		80	
Eagan's Flat.....	1, 12	33 N.	11 W.	I. W. Perry, c/o R. Perry, Mills Bldg., San Francisco.			
East Fork.....	1, 2, 11, 12	36 N.	7 W.	M. MacIlwaine et al.	2,360	56	R. XIV, p. 905.
*Eastman.....	33, 34	34 N.	8 W.	J. McCrady, 624 Upas St., San Diego.	2,100	263	R. XIII, p. 431; XIV, p. 905; Bull. 92, p. 95.
*Ehrman No. 1, 2.....	18	33 N.	8 W.	John Caton, 909 North St., Redding		40	
Elevator and Elevator No. 1.....	31, 32	40 N.	6 W.	J. Dodge and S. Wilbur, Carrville.		310	
Ellston.....	7	36 N.	12 W.	R. Ellston		20	R. XIV, p. 917.
*English Tom.....	8	33 N.	8 W.	Trinity River Mining Company, 193 Twelfth St., Oakland	2,000	247	
*Estabrook G. Dredging Co.....	4, 5, 29, 33	36 N. 37 N.	7 W. 7 W.	Estabrook Gold Dredging Company, Trinity Center		2,814	R. XIV, pp. 918-19; XVIII, pp. 258, 297, 601, 735-36; Bull. 36, p. 104; U. S. G. S. Bull. 540, p. 19, R. X, p. 707; XIII, p. 446; XIV, p. 905.
*Evans Bar.....	32	33 N.	10 W.	Carr Brothers	1,800	70	R. XI, p. 483.
Fisher Gulch.....	1 36	34 N. 35 N.	11 W. 11 W.	P. H. Jensen, Junction City		160	
*Freethy.....	28, 29	36 N.	7 W.	W. F. Detert, 995 Market St., San Francisco.		170	R. XVIII, pp. 42, 297, 497, 601, 734; Pre. Rep. No. 18, p. 18.
*Lawrence Gardella.....	3	33 N.	9 W.	Lawrence Gardella, Redding		419	R. XIV, p. 905.
Garden, Gulch.....	1, 12, 36	33 N. 34 N.	10 W. 10 W.	Mrs. M. L. Woodbury, Weaverville	2,200	86	R. XIV, p. 905.
*Gem Placer.....	13	6 N.	5 E.	Gus Perigot, Blue Lake		160	
*Gilzean Group.....	18	33 N.	10 W.	C. C. Gilzean, Douglas City; J. A. Gilzean, Junction City		70	

*Golden Eagle.....	28	36 N.	7 W.	Trinity Dredging and Hydraulic Mining Company, 719 Pacific Bldg., San Francisco.	120
Gold Dollar No. 1-5 etc.....	19, 24	34 N.	11 W.	Mary O'Neill, Weaverville; W. A. Day et al., Weaverville.	146
*Gold Dollar.....	33	33 N.	9 W.	Last Chance Mining Company.	50
Gold Ridge.....	1	33 N.	10 W.	Estate of W. H. Martin, J. W. Tinnin, c/o M. Martin, Weaverville.	1,900
Good Friday and Red Sunday.....	36	34 N.	10 W.	Estate of T. C. Post.	35
	19, 20	33 N.	10 W.		1,700
*Graf Group.....	13, 18	35 N.	11 W.	R. J. Graf, 318 Fifth St., Eureka.	1,600
	et al.	33 N.	10 W.		
*Graves.....	29, 30	37 N.	7 W.	Trinity Exploration Company, Carville.	798
*Gribble Group.....	8, 9	33 N.	10 W.	Richard Gribble, Junction City.	350
	et al.	34 N.	11 W.		282
*Hager and Haas.....	7, 18	33 N.	10 W.	Abraham, Karsky and C. H. Edwards, Weaverville.	R. XIV, p. 917.
	12	33 N.	11 W.		R. XII, p. 311; XIII, p. 448.
*Hammer Group.....					
Hang Bar.....	36	31 N.	11 W.	See South Fork.	291
E. E. Hansen.....	29, 32	34 N.	9 W.	M. Zanovich.	R. X V, p. 906.
	19, 34	34 N.	9 W.		R. XIII, p. 448.
Happy Home.....	30	35 N.	10 W.	Cons. with Dannenbrink.	
Harold Mg. and Dev. Co's Grp.....	25, 26	35 N.	8 W.	Harold Mining and Developing Company, c/o G. O. Hunter, 331 Douglas Bldg., Los Angeles.	R. XIV, p. 906.
	34, 35	35 N.	8 W.		
*Harmon and Allen.....	11, 13	33 N.	10 W.	J. W. A. C. and Louisa Meckel, Weaverville.	390
Harrison Gulch Mg. Co.....	28	30 N.	10 W.	Harrison Gulch Mining Company, c/o A. P. Stice, Red Bluff.	180
	7, 8	29 N.	10 W.		280
Haskins.....	5	36 N.	7 W.	F. Petra.	129
					R. X, pp. 698-99; XIII, pp. 448-49; XIV, p. 906.
Haunted Bar.....					R. XIV, p. 917.
Hawk Eye.....				J. L. Mushick.	100
		35 N.	11 W.	A. H. Wolfe and Mrs. G. M. Todd, 57 Soquel Ave., Santa Cruz.	
*Hawkins Bar.....	20, 21, 28	6 N.	6 E.	Eleanore I. Brizzard, Burnt Ranch.	40
*Hazel G. Mg. Co.....	14	32 N.	8 W.	Hazel G. Mining Company, Room 507, 525 Market St., San Francisco.	338
Henderson.....	13	6 N.	5 E.	Henderson & Ferguson.	320
Hidden Treasure.....				J. B. McDonald.	60
*Highland Mg. Co.....	25	5 N.	7 E.	Highland Mining Company and D. B. Lyon, c/o A. B. Champlin, Red Bluff.	60
					R. XIV, p. 907.
					R. XIII, p. 449; XIV, p. 917.

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TABLE OF PLACER MINES AND PROSPECTS, TRINITY COUNTY—Continued.

Name of mine	Location			Owner's name, address	Elevation, feet	Area, acres	Bibliography
	Sec.	Twp.	Range				
*Hilliard and Daisy	13, 24	31 N.	12 W.	George Van Gordan	2,300	315	
*Hill Crest	17	33 N.	10 W.	A. A. and F. A. Schaffer, Junction City		40	
*Hindley	5, 6	33 N.	9 W.	Clara H. Godfrey, Weaverville, and Maud W. Hupp, 12 Hill Crest Court, Berkeley		54	
*Hocker	1, 2	33 N.	11 W.	Jos. M. Hocker et al., 110 Nineteenth Ave., San Francisco	1,600	56	
Hodges Group	12	38 N.	9 W.	W. L. Hodges, Coffee		120	
*Hook and Ladder	5, 6	33 N.	9 W.	W. H. LaBaree, 2201 Glen Ave., Berkeley			
Harvey Cons.	7, 8	33 N.	9 W.	L. H. Brady, Weaverville, et al.	2,300	105	R. XIV, p. 907.
Horseshoe Bend				See Swanson Group.			
Horseshoe and Homestake	18	33 N.	9 W.	Wm. B. Testy, 729 Main St., Vallejo; C. J. Testy, Weaverville		130	R. XIV, p. 907.
Howard and Campbell	5	33 N.	12 W.	S. M. Campbell, R. D. Howard, Big Bar		35	
Humboldt Co's Group	5, 6, et al.	34 N.	8 W.	Humboldt Placer Mining Company, c/o M. J. Curless, Blocksburg	2,600	4,805	R. XIV, p. 912.
*Hydraulic Hill	32	34 N.	11 W.	The Lorenz Company, c/o E. H. Moody, Redding		38	R. XIV, p. 907.
Indian Creek	23, 26	32 N.	9 W.	Dr. D. B. Fields, Weaverville	2,100	1,744	R. XIV, p. 907.
Panocket	27, 28	32 N.	9 W.	Manuel C. De Reis, Douglas City		30	
Indian Creek	5, 8	32 N.	9 W.	G. A. Steward	2,300	60	
Ingleside	27, 28	35 N.	8 W.	Mrs. Julia Ivy, Helena	1,275	20	R. XIII, p. 450.
Ivy Gulch	3	33 N.	12 W.	Edw. Meckel and John Haley, Weaverville		40	
Jack Tar	2	33 N.	10 W.	See Barthol Jacob.			
*Jacob				Jennings Gulch Mining Company			R. XVIII, p. 450; Bull. 92, p. 95.
Jennings Gulch				H. S. Lowden, Weaverville	2,200	139	R. XIV, p. 908.
Joss	7, 18	33 N.	9 W.	Geo. F. Lewman, Junction City	1,600	20	
*Johnson Point	4	32 N.	10 W.	Russell T. Joy, 604 Mission St., San Francisco			
Joy Group	1, 12, 31	30 N.	10 W.	See Democrat Gulch.		217	
*Just in Time				F. C. Potter, F. O. Harris, J. J. Dean, F. J. Campbell, A. L. Harrington, Jas. Good-year, c/o Harrington, 308 Montgomery St., San Francisco			R. XIII, p. 452.
Katie Foley Group	10	37 N.	7 W.	C. A. Austin, Denny		51	R. XIV, p. 908.
Keystone Group				H. King et al., Big Bar		120	
King Hydraulic							

Kingsbury Koon	23, 24, 25, 26 3, 4, 9, 10, 11, 15, 22	6 N.	5 E.	Tom Collins, Hayfork. John A. and Myrtle H. Koon, Salyer	200	Bull. 85, p. 88.
*La Grange Mining Co.		33 N. 34 N.	10 W.	LaGrange Mining Company, Weaverville; c/o B. R. Brown, Weaverville; L. A. Dru, 233 Broadway, New York	5,006	R. VIII, p. 638; X, p. 702; XII, p. 311; XIII, pp. 452-53; XIV, p. 908; XVIII, p. 908; XX, p. 182; Bull. 92, p. 94.
Ladd Group		7 N.	7 E.	Grover H. and W. Ladd, Denny	60	R. XIV, p. 909.
Larsen				Larsen Brothers	40	
Least Chance et al.	13, 18	33 N.	10 W.	See Montezuma.		
Leas Group		33 N.	11 W.	Lena A. Bergin, Round Mountain, Nevada	30	
*Lewiston Gold Dredging Co.	21, 22 et al.	34 N.	8 W.	J. C. Leas, Lewiston Lewiston Gold Dredging Co., Lewiston	80 405	R. XVIII, pp. 139, 297, 601, 733; Bull. 92, p. 94; Pre. Rep. No. 8, p. 18.
Linda Marie Lister Group	32, 33 17	1 S. 33 N.	8 E. 8 W.	C. H. Mathews, Forest Glen. H. B. Lister, L. M. Lister, 805 Pacific Bldg., San Francisco	100	R. XVIII, p. 543.
Little Creek	31	32 N.	12 W.	Asa Drake, Hayfork	47	
*Little Joe	25	32 N.	9 W.	Est. of F. R. Duarte; E. L. Rogers, Douglas City	20	
Log Cabin	33	32 N.	9 W.	Wm. O. Wallace, Douglas City	40	R. XIV, p. 909.
Log Cabin Bar		7 N.	7 E.	F. Staley	120	
Long	13	33 N.	10 W.	W. W. Armentrout, Weaverville	40	R. XIV, p. 909.
Long Gulch	17	35 N.	8 W.	F. Beaudry Estate	20	
*Lorenz Group	18, 19 13	33 N. 33 N.	9 W. 10 W.	W. D. and G. C. Lorenz, Weaverville	120 303	R. XIV, p. 909. R. XVIII, pp. 97, 207, 257; XIX, p. 139; XX, p. 182; Pre. Rep. No. 8, p. 17; Bull. 92, p. 94-95.
Lower Buckeye	19, 30 29	37 N. 37 N.	7 W. 7 W.	Trinity Gold Mining Company	140	R. XIV, p. 909.
Lower Dutton's Creek	26, 35	33 N.	10 W.	J. N., W. D., G. C., F. J. Lorenz and Estate of Henry Lorenz, Weaverville	78	R. XIV, p. 909.
Lucky Mack Group				See Bower and Matlock.		
Lucky Strike and Effie Belle	13, 24 14, 23	33 N. 33 N.	10 W. 10 W.	See Democrat Gulch.	780	R. XIV, p. 910; XVII, p. 543.
Lucky Strike				C. Schwelder	60	R. XIV, p. 917.
Mahoney and Wallace				C. H. Edwards, Weaverville; Estates of N. G. and J. D. Day, Weaverville		R. XII, p. 312; XIII, p. 455.
Manuel and Santos	19	33 N.	8 W.		10	

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TABLE OF PLACER MINES AND PROSPECTS, TRINITY COUNTY—Continued.

Name of mine	Location			Owner's name, address	Elevation, feet	Area, acres	Bibliography
	Sec.	Twp.	Range				
Maple Creek	4, 5, 6 et al.	32 N.	10 W.	Maple Creek Mining Company, San Francisco.	2,000	1,594	R. XIV, p. 1910.
Martin Group	24, 30	34 N.	9 W.	Estate of W. H. Martin, Sr., c/o M. Martin, Weaverville.	59	60	R. XIV, p. 910; Bull. 92, p. 93.
McAtee Bar		7 N.	7 E.	C. S. McAtee Estabrook Gold Dredging Company, Trinity Center.			R. XVII, p. 543.
McDonald				W. H. Merson, G. O'Shay et al., c/o G. O'Shay, Junction City	1,750	1,107	R. X, p. 706; XIII, p. 455.
McGillivray et al.	26, 27, 34, 35	34 N. 34 N.	11 E. 11 E.	M. H. McIlwaine, Carrville. Trinity Consolidated Hydraulic Mining Company, L. H. Brady, Weaverville.	2,200	180	R. VIII, p. 638; X, p. 701; XII, p. 312; XIII, p. 455; XIV, p. 915.
McIlwaine Claims.	16, 22 27	38 N. 38 N.	9 W. 9 W.	J. W., A. C. and Louisa Meckel, Weaverville. W. H. Leach, Weaverville. H. D. Weinheimer, Weaverville.	2,600	150	R. XIV, p. 910.
*McMurry and Hupp	7	33 N.	9 W.	W. Brannan. Manuel Machado, Dedrick. W. H. Merson, J. S. Sullivan, et al., c/o G. O'Shay, Junction City	2,375 1,650	160 30	R. XII, p. 312; XIII, p. 455. R. XIV, p. 910.
Meckel	13, 14	33 N.	10 W.	H. W. Brannan et al., Burnt Ranch. New Blue Jay Mining Company, 3320 Geary St., San Francisco.	1,600	534	R. XIV, p. 911.
*Mike Smith	19, 30	33 N.	9 W.	William Morris et al.	3,000	76	R. XIV, p. 910.
*Mineret	2	33 N.	10 W.	I. T. and L. W. Cruthis, Douglas City.	80	30	R. XIV, p. 916.
Minersville	22, 27	35 N.	8 W.	Nash Deep Gravel Gold Mining Cons., c/o J. L. Joseph, 542 Mills Bldg., San Francisco.	5,000	866	R. XIII, pp. 464-65; XIV, p. 911; XVIII, p. 6; Bull. 92, p. 95.
Monk	5	32 N.	9 W.				R. XIV, p. 917.
Monte Christo and Apple Tree	1	34 N.	11 W.				
*Montezuma et al.	1, 2, 11, 12	33 N. 33 N.	11 W. 11 W.				
Morris Group	1, 2, 11, 12	33 N. 33 N.	11 W. 11 W.				
*Morrison Gulch	19 24	4 N. 4 N.	7 E. 6 E.				
Morris, Wm.	12, 13	37 N.	8 W.				
Mouth of Weaver	14	37 N.	8 W.				
*Nash Deep Gravel G. Mg. Cons.	25 6	32 N.	9 W.				
	6, 7	32 N.	9 W.				
	18, 27	37 N.	9 W.				
	28, 29	38 N.	9 W.				
	30, 31	38 N.	9 W.				
Negunda	12	6 N.	5 E.	H. Zeigler.			
*Nellie May	5, 6	33 N.	12 W.	Thos. Treloar, Big Bar.		20	
New Discovery	16	33 N.	10 W.	A. A. and F. A. Schaffer, Junction City.		143	

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New River.....	13	6 N.	5 E.	Ladd Brothers, Denny.....	1,650	130	R. XIV, p. 911; Bull. 92, p. 93.
Nigger Hill.....	2	32 N.	10 W.	G. Lewman.....	1,700	40	R. XIV, p. 911.
Nugget Bar.....	22, 27 4, 5	35 N.	8 W.	Van Matre helrs (owners) Nugget Bar Placer Company, Oakland (lessee).....	2,200	610	R. XVIII, p. 496; XIX, p. 140; XX, p. 182.
*O'Connell.....	33	32 N.	9 W.	William O. Wallace, Douglas City.....		104	R. XIV, p. 911.
O'Neill Group.....	11, 12	33 N.	10 W.	Sam Lee, Weaverville.....		100	
Oregon Gulch.....	2	33 N.	10 W.	Richard Gribble, Junction City.....		77	
*O'Shay Group.....	7, 8	33 N.	11 W.	W. H. Metson, Estate of Mary O'Shay, J. S. Sullivan, c/o G. O'Shay, Junction City.....		1,636	
Pacific Gold Dredging Co.....	2, 35 et al.	34 N.	10 W.	Pacific Gold Dredging Company, Carrville.....			R. XVIII, p. 258; Pre. Rep. No. 8, p. 18.
Paso Rico.....		35 N.	11 W.	A. H. Wolfe, Helena.....		73	
Patrick Holland.....	16, 17	38 N.	8 W.	Patrick Holland, 227 N. D St., San Mateo See Pickett and Stofer P. M.....	4,000	410	
Paulson Hyd.....				Alex Pelletreau, Helena.....		40	R. XII, p. 313; XIII, p. 459.
Paulson and Hughes.....		34 N.	11 W.	I. W. Perry et al., c/o Raymond Perry, Mills Bldg., San Francisco.....		56	
Pelletreau Group.....	8	33 N.	11 W.	Estates of Lucy F. and Chas. A. Phillips, c/o J. W. Phillips, Lewiston.....		53	R. XIII, p. 459.
Perry Group.....	1, 30	35 N.	11 W.	Chas., H. W., F. R. and A. E. Paulson, Lewiston.....	2,000	114	R. XVIII, pp. 97; 257; XIX, p. 139.
*Phillips.....	20	33 N.	8 W.	Frank L. Upham, Douglas City.....		40	
Pickett and Stofer.....	5, 6	33 N.	8 W.	See Danenbrink.....			
Pine Tree.....	36	34 N.	8 W.	M. H. McIlwaine and C. B. Kingsbury, Trinity Center.....		200	
Pittsburg Comstock.....	30	32 N.	8 W.	Poker Bar Mines Co., 353 Mills Bldg., San Francisco.....		80	
*Plummer Gulch, Nelson Gulch.....	11, 12	36 N.	7 W.	James J. Irving, Salyer.....		60	
*Poker Bar Mines Co.....	24	33 N.	9 W.	See Good Friday.....		30	R. XIV, p. 911.
Pony Bar.....	20, 28	6 N.	6 E.	F. Potillo.....	2,300	30	R. XIV, p. 912.
Post and Wilson.....	19, 20	33 N.	11 W.	Lorenz Brothers.....	2,000	200	R. XIX, p. 94.
Potillo.....	11	33 N.	10 W.	Frank Lynch, Hyampom.....		20	R. X. p. 709; XIII, p. 460.
Poverty Flat.....	18, 19	33 N.	9 W.	George W. Tinsley, Big Bar.....	1,360		
Precious Twins.....	17	4 N.	6 E.	J. A. Burger and Lewis Heimburger, Junc- tion City.....		58	
*Price.....	4, 5	33 N.	12 W.	Ferguson and Ziegler.....		100	R. XIII, p. 460; XIV, p. 912.
Prussian and Heimburger.....	12	34 N.	11 W.				
Quimby.....	18	6 N.	6 E.				

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TABLE OF PLACER MINES AND PROSPECTS, TRINITY COUNTY—Continued.

Name of mine	Location			Owner's name, address	Elevation, feet	Area, acres	Bibliography
	Sec.	Twp.	Range				
*Railroad and Mr. Morensis.....	9, 15 16	33 N. 33 N.	10 W. 10 W.	A. A. and F. A. Schaffer, Junction City.....	3,000	---	R. X, p. 704; XIII, p. 454; XIV, p. 912.
Rainbow.....	33	28 N.	8 W.	Rainbow Mining Company, Carrville.....	---	60	R. XIII, p. 460; XIV, p. 917-18.
Red Bank and Banon.....	7	31 N.	11 W.	Thos. Collins, Hayfork.....	---	40	R. XIV, p. 912.
*Red Flat.....	12	34 N.	11 W.	Cons. with Danenbrink.....	2,100	55	R. XIV, p. 912.
*Roe.....	1, 6	32 N.	9 W.	Trinity Consolidated Hydraulic Mining Company.....	---	36	R. XIV, pp. 912-13.
Ruby and Spanish Mike.....	31	33 N.	10 W.	B. R. Brown and Paul Pottillo, Weaverville.....	1,700	89	---
St. Marys and Live Oak.....	2	33 N.	10 W.	J. L. Morrison, Estate of John Larson, Trinity Center.....	---	40	---
*Salt Flat.....	24, 13	33 N.	9 W.	Pacifico Fancelli, 743 Howard St., San Francisco.....	---	230	---
Sam Hampton.....	23	33 N.	9 W.	C. E. Wright.....	2,400	80	R. XIV, p. 918.
Schlomberger.....	16, 17	35 N.	8 W.	Frank Schlomberger, Coffee.....	---	80	---
*Schlomer and Meckel.....	13	38 N.	9 W.	H. G. Louisa and Estate of C. C. Schlomer, Helena.....	---	100	R. XIV, p. 913.
Senger.....	29, 28	34 N.	11 W.	J. Senger.....	2,100	104	R. XIV, p. 913.
*Sheridan.....	12, 13 18, 19	33 N. 33 N.	10 W. 10 W.	W. J. Dyman.....	1,700	---	R. X, p. 703; XII, p. 313; XIII, p. 462; XIV, p. 913.
Siegfield.....	25	32 N.	9 W.	E. L. Rogers et al., Douglas City.....	---	120	R. XIV, p. 913.
Slate Creek.....	2, 3	34 N.	9 W.	F. Cadematori.....	2,700	190	---
*Smith Creek and Gibson.....	14	32 N.	10 W.	R. K. and W. S. Gibson, Weaverville.....	---	35	---
Smith Group.....	30	33 N.	10 W.	Peter D. Smith, Dedrick.....	---	560	R. XIV, p. 918.
Snow Gulch.....	21, 28	37 N.	7 W.	R. G. Abrams et al., Trinity Center.....	---	---	---
South Fork.....	22, 23 14, 15	6 N. 6 N.	5 E. 5 E.	South Fork Gold and Platinum Mining Company, P. P. Hammer, Salyer.....	660	895	R. XII, p. 133; XIII, p. 463; XIV, p. 913; Bull. 85, pp. 86-88.
Sowden.....	2	33 N.	10 W.	W. D. and G. C. Lorenz, Weaverville.....	2,200	40	R. XIII, p. 463; XIV, p. 913.
Steiner's Flat.....	35, 36	33 N.	10 W.	St. George Hotel Co., Fourth and J Sts., Sacramento.....	---	160	R. XIV, p. 914.
*Stella No. 3.....	19, 30	33 N.	9 W.	George Zinn, Coffee.....	---	80	---
Stevens Gulch.....	8	38 N.	9 W.	Ada G. McDevitt, Carrville.....	---	5	R. XVII, p. 543.
Stick to it.....	22, 10	35 N.	7 W.	---	---	---	---
Stiller.....	4	35 N.	8 W.	J. A. Stiller, Minersville or Redding.....	2,600	360	---

*Sturdivant et al.	7, 8, 9	33 N.	10 W.	Richard Gribble, Junction City	1,600	282	R. XIV, p. 914.
Swanson Group	20	6 N.	6 E.	Nels Swanson, Burnt Ranch		120	
Tanner Group	28	34 N.	8 W.	Mabel A. Tanner, 529 W. Doran St., Glendale		185	
*Teal and Perigot	18	6 N.	6 E.	Gus Perigot and Geo. F. Teal, Blue Lake		230	R. XIV, p. 905; Bull. 85, p. 89.
*Ten Cent	6	33 N.	9 W.	M. L. Woodbury, Weaverville; Nellie L. Wallace, 1006 Page St., San Francisco	2,400	80	R. XIV, p. 914.
Tenner	31	34 N.	9 W.	W. L. and R. W. Tener		240	R. XIV, p. 914.
Texas Bar	30	8 N.	8 E.	G. Vitzhum	1,800	50	R. XIV, p. 914.
Timmerman and McKenzie	6	32 N.	10 W.	John I. Adams, Weaverville	2,200	135	
T. and O.	2, 11	33 N.	10 W.	P. J. McCarthy and Leo Huebner, Box 231, Susanville		48	
Tinsley and Treloar	5	33 N.	12 W.	G. W. Tinsley and E. W. Treloar, Big Bar		240	
Tolly Hill	34	35 N.	9 W.	J. H. Cummings	2,500	160	R. XIV, p. 914.
*Tom Bell	5, 6	33 N.	9 W.	E. C. B., E. V. and K. V. B. Young, Weaverville		40	R. XVII, p. 543.
Top Notch	12, 13	6 N.	5 E.	F. Renney, Salyer P. O.	2,200		R. XIV, p. 915; Bull. 85, p. 89.
*Trinity Cons. Hyd. Mg. Co.	8, 34	33 N.	9 W.	Trinity Cons. Hyd. Mining Company		1,720	
*Trinity Dev. Co.	et al.	32 N.	10 W.	Trinity Development Company, Inc., Holbrook Bldg., 58 Sutter St., San Francisco		670	R. XIV, p. 919; XVIII, pp. 601, 734-35; Bull. 36, p. 104; Bull. 92, p. 95; U. S. G. S. Bull. 540, p. 20; Pre. Rep. No. 8, p. 18.
*Trinity Gold Dredging Co.	7, 8	37 N.	7 W.	Trinity Gold Dredging Company, Lewiston		671	
	et al.	33 N.	8 W.				
	5, 6, 7	34 N.	8 W.				
Trinity River Mining Co.	5, 8	33 N.	8 W.	Trinity River Mining Company, 193 Twelfth St., Oakland		341	R. X, p. 709; XII, p. 314; XIII, p. 465; XIV, pp. 915-16; U. S. G. S. Bull. 540, p. 20.
*Two Sisters and Wonder	25	35 N.	8 W.	Lillian N. Hassman, 2201 P St., Sacramento		80	
Tyson	30	35 N.	10 W.	C. H. Edwards, Weaverville		38	
*Union Gulch	9	33 N.	9 W.	W. Herbert Sanson, Corning		80	
Union Hill Hydraulic	6	32 N.	9 W.	Trinity Consolidated Hydraulic Mining Company	1,800	300	R. XII, p. 314; XIII, p. 465; XIV, p. 915; XVIII, pp. 97, 207; XIX, p. 58; Bull. 92, p. 94.
Unity Hyd.				See Nugget Bar and Van Matre.			
Upper Dutton Creek	26	33 N.	10 W.	The Lorenz Co., c/o Mrs. E. H. Moody, Redding, and Trinity Consolidated Hydraulic Mining Company		72	

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	Sec.	Twp.	Range				
Valdor	1, 2 et al.	33 N. 34 N.	11 W. 11 W.	Valdor Dredging Company, c/o G. A. Hutton, 582 Market St., San Francisco	---	845	R. XIV, p. 916.
Van Matre Group	22, 27 4, 5	35 N. 34 N.	8 W. 8 W.	Bertha L., E. A., G. L., W. J. and J. C. Van Matre, Loda Foster and Irene M. Vollmers, and Edna M. Browning, Minersville	---	800	R. XVIII, p. 496; XIX, p. 146; XX, p. 182.
Wallace Group	13, 14 et al.	32 N. 32 N.	9 W. 9 W.	W. O., L. S. and David Wallace, Douglas City	---	112	
*Ward	10, 11	33 N.	10 W.	Mary E. and Robert Ward and Alice J. Wain, 92 Empire St., Lynn, Massachusetts	---		
Watson Bar	23	5 N.	7 E.	G. W. Pelletreau, Big Bar	2,900	160	R. XIII, p. 638; X, p. 696; XI, p. 484.
Weaver Creek	19, 30	33 N.	9 W.	W. A. Brady, Weaverville	1,190	20	R. XIII, p. 466.
Wheaton and Stuart	8, 9	33 N.	10 W.	Richard Gribble, Junction City	---	140	
*Whitmore Gold	19	33 N.	10 W.	Estate of Jane Gribble, c/o Richard Gribble, Junction City	---	52	
*Wild Cat	34	35 N.	9 W.	J. H. Cummings and C. L. Cummings, Weaverville	1,600	44	
Wilker	5	39 N.	7 E.	J. E. Crawford	---	160	
Woodbury	35	31 N.	11 W.	---	2,200	160	R. XIV, p. 918.
*Woodbury	36	34 N.	10 W.	Frank I. Woodbury, Weaverville	---	40	R. XIV, p. 916.
					---	30	

*Indicates property patented or surveyed for patent, according to county records.

¹ Ownership shown is for the most part that in county tax records for 1924-25; but in some cases is taken from former reports, or from recent field notes, in order to show last known person claiming ownership.

The mine is at an elevation of 1800 to 2000 feet and aneroid readings indicate that the present bank is 140 feet high. The bedrock is greyish green to black mica schist. Next to it lies a bed of coarse blue gravel, covered by black, peaty clay and partly formed lignite, then fine sediments. The pay is said to be confined to about 10 feet of blue gravel next to bedrock. The balance of bank is red and yellow clayey sediment, unstratified but carrying fine, angular gravel. The pit, perhaps 10 acres in area, is completely covered, except for about one acre, to one-half the height of the bank, with caved ground (see photo) which is moving toward the outlet, and this is hampering operation. The lower layer of pay gravel is said to be rich enough to make operation profitable when bedrock can be reached.

The geology of the mine was covered in detail in United States Geological Survey Bulletins 430, 470 and 540.



Union Hill Hydraulic Mine, near Douglas City, showing pit and caved bank.

GOLD DREDGING.

The gold dredging operations in Trinity County were described by W. B. Tucker¹ in the December, 1922, issue of *MINING IN CALIFORNIA*. As there have been few changes in the dredging situation since then, the writer is referred to the above chapter, which is still available at the bureau's offices for free distribution, and only a few notes are added here. Reference to the accompanying tabulation of properties will give the acreage of land now held by dredging operators in the county. Dredgers now produce most of the gold from the county.

Estabrook Gold Dredging Company's operations have proved very profitable at times during the past year and a half. During the past summer they were hydraulicking overburden from ground 125 feet deep, preparatory to dredging. They were dredging ground 34 feet deep of which the lower 10 or 12 feet is cemented. Their dredger is the largest wooden hull dredger in the world.

¹ Mining Engineer, State Mining Bureau, formerly in charge of Redding office.

Gardella dredger is reported to have burned late in 1925.

Trinity Gold Dredging Company is at present building a new dredger on Blakenmore Ranch four miles above Lewiston. It is anticipated that it will be ready for operation by April, 1926. Their old boat had been in use 12 years.

Upstream on Trinity River above the present holdings of the Estabrook Company, Pacific Gold Dredging Company operated a dredger for some time near Carrville and drilled additional ground near that village that was not worked. The dredger was dismantled in 1922 and shipped to the Federated Malay States. The company had previously attempted to operate the same dredger on Coffee Creek above Carrville, but had been forced to quit because of the heavy boulders, although considerable gold was reported on bedrock. In some places along Trinity River bedrock is hard and the cost of replacing worn and broken parts is reported high.

Other areas that have been drilled are the Hayfork Valley, containing about 10,000 acres, of which two-thirds are gravel, and some small areas on Trinity River near the mouth of the South Fork, as well as above Junction City. The Valdor dredger, from which the machinery of the present Lewiston Gold Dredging Company's dredger came, was operated on Trinity River five miles below Junction City on gravel averaging 24 feet deep, embracing old placer diggings on limestone and serpentine bedrock.

Bibl: Cal. State Min. Bur. R. XIV, p. 918; R. XVIII, pp. 733-736 (Mining in California, Monthly, Dec. 1922, pp. 733-736). Bull. 85, pp. 84-85.

GRANITE.

A little granodiorite has been quarried on Rush Creek, six miles east of Weaverville, for local use for monuments and buildings.

LIMESTONE and MARBLE.

Limestone and marble are common in the county, but have been developed very little on account of distance from markets. It occurs in both the so-called 'Pre-Cambrian Metamorphics' and in rocks of known Devonian age. Local use has been made in Weaverville of limestone quarried on Brown's Mountain in Sec. 21, T. 33 N., R. 9 W., and in Sec. 3, T. 33 N., R. 10 W. This was burned in small kilns, but there has been no recent production. The remoteness of the county, and small local population, preclude the development of deposits.

Bibl: Cal. State Min. Bur. Bull. 38, p. 94. R. XIV, p. 920. Diller, J. S., Amer. Journal of Science, 4th Series, Vol. 15, p. 342.

MANGANESE.

Manganese oxide ore occurs in the region of the headwaters of the South Fork and Hayfork of Trinity River, and in the southwestern part of the county, and in the southern part near the Mendocino County line. The last two areas are in the Franciscan rocks, and the deposits are similar geologically to those worked elsewhere in the Coast Ranges. Possibly other deposits might have been developed had the war continued, but work stopped when high war-time prices fell.

The *Caudwell Prospect* in N $\frac{1}{2}$ of Sec. 21, T. 28 N., R. 11 W., the *Johnson Prospect* in Secs. 9 and 10, T. 28 N., R. 11 W., and *Selvester* and *Wilson Prospect* in SE $\frac{1}{4}$ of Sec. 34, T. 29 N., R. 11 W., and other prospects, lie at elevations of from 4000 to 5000 feet, on the divide at the headwaters of South Fork and Hayfork of Trinity River, 70 to 72 miles from Redding, the nearest railroad shipping point, and 14 miles of this is trail from Wildwood. The first named was a promising showing but undeveloped. The second was prospected and some ore mined, but not shipped.

Naphis Peak Mine is three miles northeast of Kekawaka Siding on the Northwestern Pacific Railroad. It produced a few carloads of ore in 1916 and 1917.

Red Cliff Prospect is in Sec. 36, T. 25 N., R. 13 W., near the southern county line.

McKnight and *Kindred* deposit is 3 $\frac{1}{2}$ miles northeast of Jewett Siding on the Northwestern Pacific Railroad. Low grade ore was developed.

Bibl: Cal. State Min. Bur. Bull. 76, pp. 90-91.

MINERAL PAINT.

Red ocher occurs in Sec. 15, T. 35 N., R. 8 W., on the east side of East Fork of Stuarts Fork; and in Sec. 9, T. 35 N., R. 8 W.

Bibl: Cal. State Min. Bur. Bull. 38, p. 342.

MINERAL WATER.

Deer Lick Springs. Owners, California Medicinal Springs, care H. R. Given, Weaverville. The property contains 106 acres, patented, in Secs. 6 and 7, T. 30 N., R. 9 W., near the eastern county line, and is reached by trail only. Elevation is 3000 feet.

These springs have enjoyed for many years a local reputation for efficacy in the treatment of blood diseases, and many stories are told of remarkable results had in cases where sick people have camped at the springs for a short time and used the water daily. The water was placed on the market several years ago under the name "Nipicuro," but there has been no recent output. There are few improvements and no buildings for the accommodation of guests, and visitors bring their own outfits. The springs are 28 miles by road and trail south of Weaverville or nine miles by trail from Knob, Shasta County.

There are five springs in the group, giving a total flow of about eight gallons per minute of cold water, which is highly sulphuretted and contains also quite a large amount of calcium, sodium and the chloride radical. The springs are described in detail, with analyses, in U. S. Geological Survey Water Supply Paper 338, pp. 261-263.

Other sulphur springs have been noted along Browns Creek, one mile and more downstream from Deer Lick Springs, but these have never been improved or utilized.

MOLYBDENUM.

Molybdenum occurs on Grass Valley Creek, four miles from Lowdens Ranch. The location is given as Sec. 31, T. 33 N., R. 8 W. and molyb-

denite and molybdenite are reported. Molybdenite has also been mentioned as occurring near Helena. Both showings are believed to be small, and are undeveloped.

Bibl: Cal. State Min. Bur. Bull. 91, p. 32.

PLATINUM GROUP METALS.

Metals of this group have been found in various parts of the county, particularly in gravel on the benches and bars of Trinity River from Dutch Creek, above Junction City, for several miles downstream; in New River district; on Hayfork Creek, and on the main river and its south fork in the area adjacent to their junction. So far, the metals have been found only associated with gold in the gravel deposits, and have not yet been found in place. In 1917, the writer covered the subject for the State Mining Bureau in cooperation with geologists of the United States Geological Survey, and the results of this field work were published as Bulletin 85 of the State Mining Bureau. At that time claims were being made that prospects of platinum in veins had been found in the vicinity of Soldier Creek and nearby, upstream from Junction City, and the party covered the district in detail but were unable to find anything to substantiate the reports.

The hydraulic mines a short distance upstream from Junction City, particularly the old Chapman and Fisher Mine, produced numerous nuggets of platinum metals up to one ounce each in weight. The wash in these mines, between Dutch Creek and the Jacob Mine is characterized by enormous boulders, which are not seen in the river gravel above Dutch Creek. The platinum metals also disappear at the same place, and no record could be found of platinum production farther upstream on Trinity River, although two dredgers were then operating, one near Lewiston and one near Trinity Center. Neither is there any record of the production of platinum from the La Grange Mine, a short distance east of Junction City on a Tertiary channel of Trinity River, where a very large yardage was handled and an efficient system of gold saving was in use. At the same time, platinum group metals were saved in some quantity at the Valdor dredge, which operated in the river five miles below Junction City.

The proportion of platinum metals to gold in these placers was small, although much higher than in Yuba County and elsewhere in the state. Over a period of several months, the ratio of platinum to gold (by value) was $1\frac{1}{4}$ to 100 on the Valdor dredge. The platinum metals were recovered principally by hand panning of the long tom concentrate, which was the product obtained by running the black sand from the dredger through a long tom several times. The platinum group metals occur in this district as fine flakes (probably composed chiefly of platinum) and as crystalline, sharp-edged pieces and nuggets up to an ounce in weight. The angular pieces and the nuggets are a native alloy of osmium and iridium as well as platinum, and for this reason the term 'platinum group metals' is the only accurately descriptive one available. Osmiridium and platiniridium are much harder than platinum and less easily soluble. While platinum has a hardness of only 4 to 4.5 and is so malleable as to be hammered into flakes in the streams, the alloys named have a hardness of 6 to 7, are too hard to be scratched by a knife, and retain their crystal form and brilliant

metallic luster on the clean cleavage faces. Osmiridium is chiefly valuable for its iridium content, which is much in demand for manufacturing standard weights and measures, fine tools, knife edges in sensitive balances, and tips for fountain pens. 'Hard platinum,' containing 90% platinum and 10% iridium, is much used in electrical equipment, such as contact points on magnetos. Analyses of platinum group metals recovered on the Valdor dredge in 1917 indicated 40% to 43% platinum, and 47% to 58% osmiridium. This dredge was dismantled and moved to the Lewiston district late in 1922. Since then the platinum production of the district has practically ceased.

In the other districts mentioned in this county as producing platinum the mode of occurrence is similar to that near Junction City, the few ounces produced annually being a by-product of a few small hydraulic mining operations. The region near the mouth of the South Fork of Trinity River is now the most interesting in the county from the standpoint of platinum metal possibilities. There are hydraulic mines there which, while yielding a satisfactory gold output, appear to carry a higher ratio of platinum group metals than other properties. These mines have so far been operated only on a small scale due to scarcity of water. Among them may be named the Hammer Group, Oro Corono and Teal and Perigot, described under placer mines herein. No analyses are available for this district, but the platinum metals appear to be similar in content to those near Junction City. The output of these metals for the entire county was only 11 ounces in 1924.

QUICKSILVER.

Quicksilver was produced in the Altoona district prior to 1875, by washing gravel containing cinnabar which came from erosion of the veins. The Altoona Mine prior to 1875 is estimated to have produced 1000 flasks¹ of mercury, and since that year this property is said to have produced about 28,000 flasks of a total of a little over 31,000 flasks credited to the county. There has been no production for three years past.

The productive area is in the northeastern part of the county in sections 15, 22 and 23, T. 38 N., R. 6 W., and is reached by the Ramshorn road running west from Castella. Other prospects have been noted in the vicinity of Carrville, in New River district, and near Canyon Creek, south of Dedrick.

Altoona Quicksilver Mine. Owner, Altoona Quicksilver Mining Company, 216 Pine Street, San Francisco. It includes three patented claims, Trinity, Altoona and Central, containing 54.6 acres, in Sec. 22, T. 38 N., R. 6 W., and 400 acres of other patented land in the N $\frac{1}{2}$ of Sec. 26, and NE $\frac{1}{4}$ of Sec. 28, T. 38 N., R. 6 W. The Altoona and Boston ditches and water rights in Crows Creek and Wilts Ravine are also claimed. The elevation is 4625 feet and the property is reached by 20 miles of road (the Ramshorn grade) from Castella.

This area is mostly covered by serpentine, which contains chromite mines and asbestos prospects. The quicksilver occurs as cinnabar in an altered rock, apparently originally porphyry. The property has been described in numerous past publications, and the following paragraph

¹ Cal. State Min. Bur. Rep. IV, p. 336.

is quoted from the latest of these.¹ There is nothing new to add to this, as later operations consisted in cleaning up on the surface.

"There are four veins, three coming together at the lowest level, forming a mineralized zone 400' long, and from 4' to 50' wide. The ore appears to be a contact deposit between serpentine and 'porphyry.' The footwall is serpentine. The workings consist of a vertical shaft 450' deep, with five levels. In the lowest level, a winze, 152 feet deep was sunk, from which two levels were driven. There are seven levels in all, covering a territory of 1600 feet in a northwest and 1120 feet in a northeast direction, within which four different veins were worked to a depth of 600 feet. The mine makes considerable water, and was shut down in 1902, when fire destroyed part of the reduction plant, which has since been repaired. The reduction plant includes a Knox & Osborne fine-ore furnace, and a retort. Water supply is obtained from Crow Creek, between the east and north forks of Trinity River. There is abundant pine and fir timber in the vicinity."

Bibl: Cal. State Min. Bur., Reports IV, p. 336 (table); VIII, p. 643; X, p. 716; XI, pp. 481, 482; XII, p. 371; XIII, pp. 603-604; XIV, p. 923. Chapter rep. bien. period, 1913-1914, p. 179. Bull. 27, pp. 192, 219; Bull. 78, pp. 200-201. U. S. G. S., Mon. XIII, p. 366. Min. Res. W. of Rocky Mts., 1875, p. 20; 1876, p. 19.

Anna Bell Cinnabar Mine. Owner, John Burger, Junction City. It contains 40 acres, unpatented in Sec. 1, T. 34 N., R. 11 W., $2\frac{1}{2}$ miles south of Dedrick. Assessment work only.

Carr Quicksilver prospect. One claim, in Sec. 22, T. 38 N., R. 6 W. Idle, and ownership unknown. A few open cuts run years ago showed some cinnabar. Adjoins Altoona Mine on the east.

Bibl: Cal. State Min. Bur. Bull. 27, p. 193; R. XIV, p. 924.

Integral Quicksilver Mine. Owner of four-fifths interest, Wm. J. Simpson, 91 Park Row, New York. The holdings include the Integral Consolidated, Boston, Invincible and other patented claims, and a number of sections of timber land, a total of 2604 acres, in Secs. 14, 15, 21, 22, 23, and 27, T. 38 N., R. 6 W., reached by the Ramshorn road from Castella. The mine workings are near the corner common to sections 15, 22 and 23. The ore occurs in lenses in or at the contact of serpentine. According to Wm. Forstner,² "In this serpentine lies a body of highly altered rock, probably an altered feldspar porphyry, as far as ascertained, in the form of an irregular lens with a north-westerly dip. In the parts of the lens which carry ores the material is thoroughly decomposed by the action of the mineral-bearing waters which deposited therein iron and mercury sulphides, the former being largely, if not entirely, weathered into iron oxides, decomposing the gangue rock and giving it a yellow and black color."

At the time of Forstner's visit, in 1903, the mine had been opened by a shaft 180 feet deep, with five levels, several hundred feet of drifts and crosscuts having been run to explore the orebody. The

¹ Bradley, Walter W., Cal. State Min. Bur. Bull. 78, p. 201.

² Cal. State Min. Bur. Bull. 27, p. 194.

Castella Development tunnel, 2760 feet long, was 120 feet below the 180-foot level, and was connected with it by a vertical winze. Some ore was produced and a small production of mercury made, using a 24-ton Knox and Osborne furnace. Nothing has been done in recent years.

Bibl: Cal. State Min. Bur., Reports, XII, p. 373; XIII, p. 604; XIV, p. 924; Chapter rep. bien. period, 1913-1914, p. 180; Bull. No. 27, pp. 193-195; Bull. 78, p. 202.

Overland Prospect is in New River district and has been slightly prospected by A. E. Yocum, the last owner according to our records. It is 40 miles by trail from the Trinity River highway.

Bibl: Cal. State Min. Bur. Bull. 78, p. 202.

Trinity Prospect. Owner, Trinity Quicksilver Mining Company, 58 Sutter St., San Francisco. Contains 51.3 acres, patented, in Secs. 21, 22, T. 38 N., R. 6 W., adjoining the Altoona Mine on the northwest. Not recently active, and undeveloped.

SOAPSTONE.

Soapstone occurs on Browns Mountain in Sec. 21, T. 33 N., R. 9 W., and has been used locally in fireplaces.

Bibl: Cal. State Min. Bur. Bull. 38, p. 353.

VOLCANIC ASH.

Liberty Bell Mine. Owners, F. and L. Sarcletti, J. Mercieri and J. Dallatore, French Gulch. It is in Minersville district, 35 miles from Redding, in Sec. 13, T. 34 N., R. 8 W.

The deposit consists of andesitic ash and has been prospected by an adit which was started to cut at depth a quartz vein which is said to have assayed \$15 a ton on the surface.

Bibl: Cal. State Min. Bur. R. XVII, p. 544.

SAN FRANCISCO FIELD DIVISION.

C. McK. LAIZURE, Mining Engineer.

SANTA CRUZ COUNTY.

Introduction.

Numbered among the original twenty-seven counties created February 18, 1850, Santa Cruz County was first known as Branciforte.¹ An amendment passed later during the first session of the legislature gave it the name of Santa Cruz, signifying 'Holy Cross.' With the exception of its northern boundary, which originally extended from the ocean due east through a point at the head of San Francisquito Creek to the summit of the Santa Cruz Mountains, the original boundaries of the county were the same as they are at present. In 1868 the northern line was moved southward and a portion of what had been Santa Cruz County was annexed to San Mateo, which had been created in 1856. The new dividing line began on the ocean shore near Point Año Nuevo, trending northeasterly to the summit of the mountains in a broken line of east and north bearing segments. Since this move in 1868 the county's boundaries have remained unchanged.

Geography.

Santa Cruz County borders on Monterey Bay and the Pacific Ocean, its curving coast-line extending from the mouth of Pajaro River, where it enters the bay, northwesterly for 40 miles. San Mateo County bounds it on the north; Santa Clara County lies to the northeast, and Monterey adjoins on the south.

The area of the county is only 435 square miles, making it, exclusive of the city and county of San Francisco, the smallest county in the state. Its population is 26,269 (1920 census). The city of Santa Cruz, the county seat, situated on the north shore of Monterey Bay, is one of the most attractive seaside resorts of California. It is noted for its long strand of bathing beach and equable climate, and is easily reached from San Francisco, 78 miles north, by rail or highway.

The county is traversed by a line of the Southern Pacific railroad from San Jose, via Los Gatos, to Santa Cruz. From there this line continues southeasterly near the coast to Watsonville, the second city in size and principal shipping center of the rich Pajaro Valley, connecting with the main line at Watsonville Junction. There is a branch line from Felton that follows San Lorenzo River northward, and another from Santa Cruz, running northwesterly along the coast to the plant of the Santa Cruz Portland Cement Company at Davenport.

A municipal pier at Santa Cruz permits the docking of ocean-going vessels. Good highways make the county readily accessible to motorists.

Pajaro Valley is noted as an apple growing district. The cultivation of fruits, berries and vegetables and the operation of packing plants and canneries are the principal industries. Poultry raising, commercial fisheries and mining are also important. The latter industry, however, is confined almost entirely to the production of nonmetallic structural and industrial minerals.

¹ Coy, Owen C., California County Boundaries, California Historical Survey Commission, Berkeley, 1923.

Topography.

The greater part of Santa Cruz County is rugged and mountainous. Castle Rock Ridge, which forms the eastern boundary, trends in a northwest direction, approximately parallel to the coast line at an average distance of 20 miles inland. It rises to elevations of over 3000 feet and forms an escarpment with a steep northeastern slope on the Santa Clara County side. To the southeast, between the summit and the ocean, the slope is more gradual, but the region is cut by many deep gulches formed by streams flowing westward to the sea.

Ben Lomond Mountain, which rises between Castle Rock Ridge and the ocean, also presents a steep escarpment to the northeast and a long gentle slope on the southwest to the ocean. The parallel arrangement of valleys and ridges characteristic of much of the Coast Range is not prominently developed in this county. Old sea terraces are noticeable at many places along the coast. The hillsides are generally deeply soil-covered and unusually steep, there being many V-shaped canyons in the Monterey shale areas.

In the region of San Lorenzo River and Boulder Creek the hills are heavily wooded and several redwood groves contain trees of gigantic size. The drainage basin of San Lorenzo River includes nearly one-third of the county. Pajaro River drains the southern portion, flowing westward and forming the south boundary of the county. Numerous small perennial streams flow down the west side of Ben Lomond Mountain to the sea.

Geology.

The Santa Cruz Quadrangle, the geology of which has been mapped and described by J. C. Branner, J. F. Newsom and Ralph Arnold,¹ includes the greater portion of the county. The reader is referred to this folio for a detailed geological history of the area and description of the formations.

That half of the county lying northwest of the Southern Pacific railroad (excluding only the Ben Lomond Mountain block) and Castle Rock Ridge along the eastern boundary are composed of Tertiary (Miocene) marine sandstones and diatomaceous shales. The area east of Santa Cruz and extending to the base of Castle Rock Ridge is also composed of Tertiary (Pliocene) sedimentary formations, including marine and freshwater sandstones, shales and gravels. Quaternary sands, gravels and clays predominate along the southern boundary and Pajaro River Valley. Ben Lomond Mountain is an upward-tilted granitic block, the core of which is quartz-diorite but containing relatively small areas of metamorphic schist, marble and limestone. All of the sedimentary formations have been much folded, crushed and broken and numerous faults have been noted.

Mineral Resources.

Records covering the variety, amount and value of the minerals produced in Santa Cruz County extend no farther back than 1894, but there was considerable production before that time, especially of gold, bituminous rock, limestone and lime.

¹ U. S. Geol. Survey Santa Cruz Folio No. 163.

Although it was 44 years after the organization of the county and 46 years after mining became an established industry in the state before any segregated county record of output was begun, in the succeeding interval of 31 years between 1894 and 1924, inclusive, the total recorded value of minerals produced has amounted to nearly \$50,000,000. This large total includes no metals except a negligible amount of magnetite (iron ore) from black sand; no petroleum, the most valuable nonmetallic found in the state; and no 'war minerals,' the production of which materially increased the mineral output of many of the counties from 1915 to 1918.

In 1924 the mineral output of Santa Cruz County was valued at \$4,339,233, giving it tenth place among the fifty-eight counties of the state. As will be noted by referring to the table of mineral production, the variety of commercial minerals is small and practically confined to the structural materials, bituminous rock, cement, clay, lime, and limestone, sand, gravel, and crushed rock. A number of other minerals are known to occur in the county, but they are of minor importance at their present stage of development. Among these are coal, gold, granite, iron, mineral water, and petroleum. Still other varieties mainly of mineralogical interest are cinnabar, graphite, gypsum, melanterite, and talc. Magnetite, chromite, ilmenite, garnet, olivine,

SANTA CRUZ

Year	Lime		Limestone	
	Barrels	Value	Tons	Value
1894	167,000	\$138,200	4,000	\$5,000
1895	145,000	133,750	12,055	12,055
1896	116,000	95,500	27,827	28,663
1897	149,600	111,800	10,688	8,005
1898	151,000	151,000	7,912	5,738
1899	161,893	176,893	4,135	3,730
1900	163,985	131,288	1,669	1,213
1901	161,500	161,500	3,845	3,595
1902	185,223	161,302	1,850	1,850
1903	220,835	185,442	3,000	2,725
1904	293,207	306,775	2	-----
1905	218,084	199,974	7,325	52,125
1906	255,469	347,490	11,431	55,242
1907	213,599	241,179	6,370	6,000
1908	119,996	119,996	1,178	2,167
1909	228,875	296,785	3,457	5,273
1910	214,137	230,513	4,361	6,770
1911	216,508	206,225	22,622	44,591
1912	169,646	159,505	7,307	7,553
1913	75,000	60,000	39,494	30,994
1914	173,282	157,011	14,666	25,082
1915	191,643	177,873	2,047	4,873
1916	176,263	225,485	4,318	9,820
1917	213,104	173,778	6,527	11,378
1918	182,083	285,316	7,132	15,313
1919	150,271	234,039	5,527	12,690
1920	141,633	202,908	5,062	20,101
1921	122,907	242,869	2	-----
1922	174,490	235,802	4,581	20,534
1923	157,660	203,632	6,733	14,242
1924	127,830	212,540	2	-----
Totals	5,437,723	\$5,732,411	227,119	\$614,561

¹Includes crushed rock, rubble, sand, gravel.

²See under 'Unapportioned.'

zircon, quartz, and platinum are constituents of some of the beach sands.

Further development may place some of these on the commercial list, but the future production of Santa Cruz County will no doubt continue to be made up chiefly of the common structural and industrial nonmetallies which have contributed most to its mineral production in the past.

The last general report on the mines and mineral resources of the county is contained in State Mineralogist's Report XVII, 1920. The oil possibilities were discussed in Bulletin No. 89, 'Petroleum Resources of California,' 1921 (out of print).

In order that these data might conform to the new series of county reports, begun in State Mineralogist's Report XXI, 'Mining in California,' 1925, and continued in succeeding numbers, the county was visited in January, 1926. New developments, corrections and changes noted since the former reports were published are included herein.

The courteous assistance rendered by local chamber of commerce officials, property owners and operators is gratefully acknowledged.

The following table gives the total recorded output, 1894-1924, inclusive:

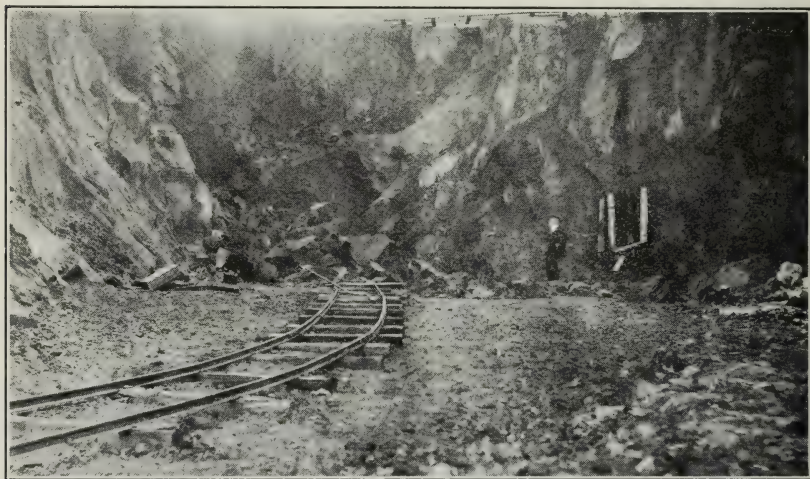
COUNTY, 1894-1924.

Bituminous rock		Miscellaneous stone ¹ , value	Miscellaneous and unapportioned		
Tons	Value		Amount	Value	Substance
20,782	\$79,980				
32,067	102,486	\$4,000	75 M.	\$375	Brick.
43,843	109,536	4,000	497 M.	2,485	Brick.
43,179	123,056		300 M.	1,500	Brick.
40,598	113,898				
27,503	70,569	200			
21,960	58,590				
13,580	30,654		10 tons	30	Clay.
31,700	41,084		106 tons	1,060	Asphalt.
18,426	45,190	20,750	700 cu. ft.	140	Granite.
		2,925			
17,583	42,500	1,750			
13,544	38,860	3,500			
21,955	64,707	14,800			
		19,736			
25,041	85,123		450 cu. ft.	336	Granite.
		20,717	28,400 tons	28,400	Clay.
31,392	110,067		63,541 tons	13,800	Clay.
		23,425		1,794,294	Unapportioned, 1900-1909.
35,565	124,195		52,970 tons	15,981	Clay.
24,815	80,371	7,627		2,096,031	Unapportioned.
32,146	80,439	22,710		2,448,339	Unapportioned.
26,932	67,330	10,511		879,437	Other Minerals.
40,540	115,500	4,276		1,647,970	Unapportioned.
17,399	60,728	6,794		1,341,089	Unapportioned.
		2,815		1,331,263	Unapportioned.
		2,368		1,440,991	Cement, marble, bituminous rock.
		2,368		1,480,800	Cement, potash, bituminous rock.
		9,107		2,599,717	Cement, potash, bituminous rock.
		17,074		1,981,253	Other minerals.
		23,379		2,834,750	Bituminous rock, cement, iron ore, mineral paint, potash.
		22,895		3,815,121	Bituminous rock, cement, limestone, mineral paint, potash.
		7,398		3,345,071	Cement, bituminous rock, potash.
		15,363		3,992,668	Cement, bituminous rock, potash.
		29,217		4,097,476	Cement, bituminous rock, potash, limestone.
\$580,550	\$2,225,363	\$277,337		\$37,190,287	

BITUMINOUS ROCK.

The deposits of asphaltic and bituminous rock in Santa Cruz County have long been known and utilized. The material is a porous, loose, fine to fairly coarse-grained sandstone, impregnated with asphaltum. These so-called bituminous rock deposits are extensive, but they have been developed at only a few places. As described by H. W. Fairbanks,¹ "The bituminous rocks are sandstone beds lying near the base of the diatomaceous shale, which is referred to as the Monterey. Most of the sandstone beds which immediately underlie or are intercalated with the diatomaceous shale of this locality are more or less bituminous. The structure is monoclinal, with a gentle southwest dip, hence the asphaltic-bearing strata crop out along the sides of the southwestward-flowing streams, where these have cut down nearly or quite to the bottom of the shale.

"The zone of the bituminous rock is exposed near the base of the diatomaceous shale from Santa Cruz northwestward as far as the



Middle bed (soft) bituminous sandstone, thickness about 30 feet, City Streets Improvement Company's Mine, Santa Cruz County.

western side of the Big Basin, a distance of more than 20 miles. Throughout this distance the dip of the lower part of the diatomaceous shale and of the immediately underlying sandstone is gently to the west and southwest. At many places through this district the sandstone beds are more or less bituminous, but at only one locality have they been found to be of commercial value."

City Streets Improvement Company's Mine. Under various names, including Walrath Mines, Pacific Improvement Company's Mine, Santa Cruz Bituminous Rock Mines, and more recently City Streets Improvement Company's Mine, this property has been operating for more than 35 years. Operations have been on a reduced scale in later years, the City Streets Improvement Company having gone out of

¹ Fairbanks, H. W., U. S. Geol. Survey Folio 163.

business and control of the property passed to the Bank of California, N. A., San Francisco. Since February, 1923, it has been operated under a working agreement by I. W. Moore, Box 433, Santa Cruz.

The property contains 479 acres, located low down on the southern slope of Ben Lomond Mountain at an elevation of 800 to 900 feet. The workings are three miles northeasterly from Gordola, the shipping point on the Davenport branch of the Southern Pacific, and about five miles in an air line northwest of Santa Cruz.

There are three distinct beds of bituminous sandstone lying practically horizontal on the property.

The lower stratum is about seven feet thick and has not been developed to any extent, as work has been confined to the upper and heavier beds. About eight feet of sand, containing a very low percentage of bitumin, separates the lower bed from the middle one. The latter is a rather coarse-grained sandstone averaging 30 feet in thickness containing from 10% to 14% of asphalt. The 'soft' bituminous rock is mined from this bed. Above this there is a bed of diatomaceous shale 50 to 60 feet in thickness, on top of which is the upper stratum of bituminous sandstone. The upper bed is a little thinner than the middle one, varying from 6 to 22 feet in thickness. It is finer-grained and harder, but contains from 14% to 18% asphalt. The 'hard' rock is mined from this bed. In use, a varying mixture of the 'hard' and 'soft' rock is used, according to the character of the work.

In early days the material was hauled to the loading station at Gordola by an immense steam tractor, hauling four or five large trailers with solid wooden wheels holding ten tons each. Much of this old equipment is still on the property.

At the present time the bituminous sandstone is mined by boring holes with augers, and blasting; the large pieces being broken to man-size with sledge and chisel. It is then loaded on 2-ton cars by hand and trammed to a loading bunker from which it is taken by 5-ton trucks to Gordola.

Many thousands of tons of this material have been produced here in the past 35 years; the entire top of Rattlesnake Hill having been cut down to a level floor representing the base of the middle bed of bituminous sandstone. The beds are still exposed in open cuts for over 1000 feet on adjoining hills, and an immense tonnage still remains readily accessible. When properly placed, the excellency of this material has been demonstrated by pavement laid 30 years ago which is still in good condition. Two to five men are employed.

Bibl: State Mineralogist's Reports XII, p. 28; XIII, p. 43; XVII, pp. 230-232; XVIII, p. 228. U. S. Geol. Survey 22d Annual Report, Part I, pp. 384-394; Santa Cruz Folio 163. California Journal of Technology, August, 1913.

Cowell Mine. This quarry is situated six miles northwest of Santa Cruz on the extensive land holdings of the Henry Cowell Lime and Cement Company, owners. It is about one-half mile east of the City Streets Improvement Company's Mine, but on the opposite side of Baldwin Creek, which necessitates hauling direct to Santa Cruz for

shipment. It has only been worked occasionally in a small way, and was idle at the time of visit.

Bibl: State Mineralogist's Reports X, p. 621; XII, p. 28; XIII, p. 44; XVII, p. 230; XVIII, p. 228. U. S. Geol. Survey 22d Annual Report, Part I, pp. 399-404; Santa Cruz Folio 163.

Thurber's Mine. This property is north of and adjoining the City Streets Improvement Company's Mine. The bed of bituminous sandstone here varies from 10 to 30 feet in thickness. It has not been extensively developed. Idle. Owner, Consolidated Bituminous Rock Co., Nevada Bank Building, San Francisco.

Bibl: State Mineralogist's Reports VII, p. 96; VIII, p. 554; XII, p. 29; XIII, p. 44; XVII, p. 232; XVIII, p. 228. U. S. Geol. Survey 22d Annual Report, Part I, pp. 393-396; Santa Cruz Folio 163.

BLACK SAND.

There are extensive stretches along the coast of California where the heavier constituents of the beach sands have been concentrated by wave action into deposits of so-called 'black sand.' The composition of this heavy concentrate varies somewhat with the locality. In general the following commercial minerals are present in greater or less amount: magnetite, gold, ilmenite (oxide of iron and titanium), garnet, zircon, hematite, chromite, and the platinum group metals.

Could each of these minerals be readily and completely separated from the others and from the olivine, quartz and other worthless constituents, they would be readily marketable. Gold and platinum are found in relatively minute amounts only, but on account of their high value, practically all past efforts to work these sands have been confined to the recovery of these metals.

Besides the uncertain profitable production of gold and platinum from this source, the use of black sand in the manufacture of artificial iron castings, where great strength is not required, has been suggested. Some experimental work has been carried on along this line including the making of sash-weights by molding or briquetting the material into the desired form with oxy-chloride (magnesite) cement, portland cement, or other binder. Black sand may also be utilized in concrete mixes where a concentrated weight is wanted, as in concrete balance-weights used on bascule-type bridges and similar structures.

By subjecting the magnetite in black sand to an oxidizing roast, it may be changed to the ferric state, producing a red oxide (Fe_2O_3), which forms when finely ground a mineral pigment suitable for the manufacture of paint. The pigment so made is said to be superior to ground hematite or the natural soft red oxide.

Magnetite in the black sands is obviously also an ore of iron. With reference to this, Day and Richards¹ in their report on the useful minerals in the black sands of the Pacific slope state, "It was found that the magnetite contained in the black sands of the Pacific slope constitutes a greater supply of useful iron ore than any other available source known on the Pacific slope. This magnetite usually contains

¹ Day, David T., and Richards, R. H., Useful Minerals in the Black Sands of the Pacific Slope, U. S. Geol. Survey Mineral Resources, 1905, pp. 1175-1258.

from 5 to 10 per cent of titanium. It was found that this titanium offered no obstacle to the production of high-grade cast iron in the electric furnace, and that in a modification of this electric furnace this cast iron could even be decarburized to a very soft iron of high quality."

Well-known deposits of black sand occur in Santa Cruz County along many of the beaches, particularly on the northern shore of Monterey Bay from the mouth of Pajaro River to Soquel Point. The deposits are found both on the present beaches and on the older marine terraces back from the present shore line. They occur in strata from a few inches to several feet in thickness, interstratified with light beach sands. They are said to carry small amounts of platinum, as well as gold, and have been washed in the vicinity of Leonard Station and near Aptos at intervals for many years, though probably with little if any profit. Typical analyses of the natural black sand near Aptos, according to Day and Richards,¹ show their content in the following minerals to be:

Magnetite -----	502 to 1120	pounds per ton
Chromite -----	8 to 126	pounds per ton
Ilmenite -----	224 to 576	pounds per ton
Garnet -----	1 to 80	pounds per ton
Quartz -----	216 to 1046	pounds per ton
Zircon -----	18 to 26	pounds per ton
Unclassified -----	104 to 189	pounds per ton
Gold -----	none to 62	cents per ton
Platinum -----	none	

At the time of visit, no one was found attempting to extract gold or platinum, but there is now a plant near Aptos utilizing the black sand as an iron ore. For a description of this plant see under Iron.

CEMENT.

Cement is the most important single structural material in the mineral output of California. As a cement producer, the state ranks third in the United States, being surpassed only by Pennsylvania and Indiana.

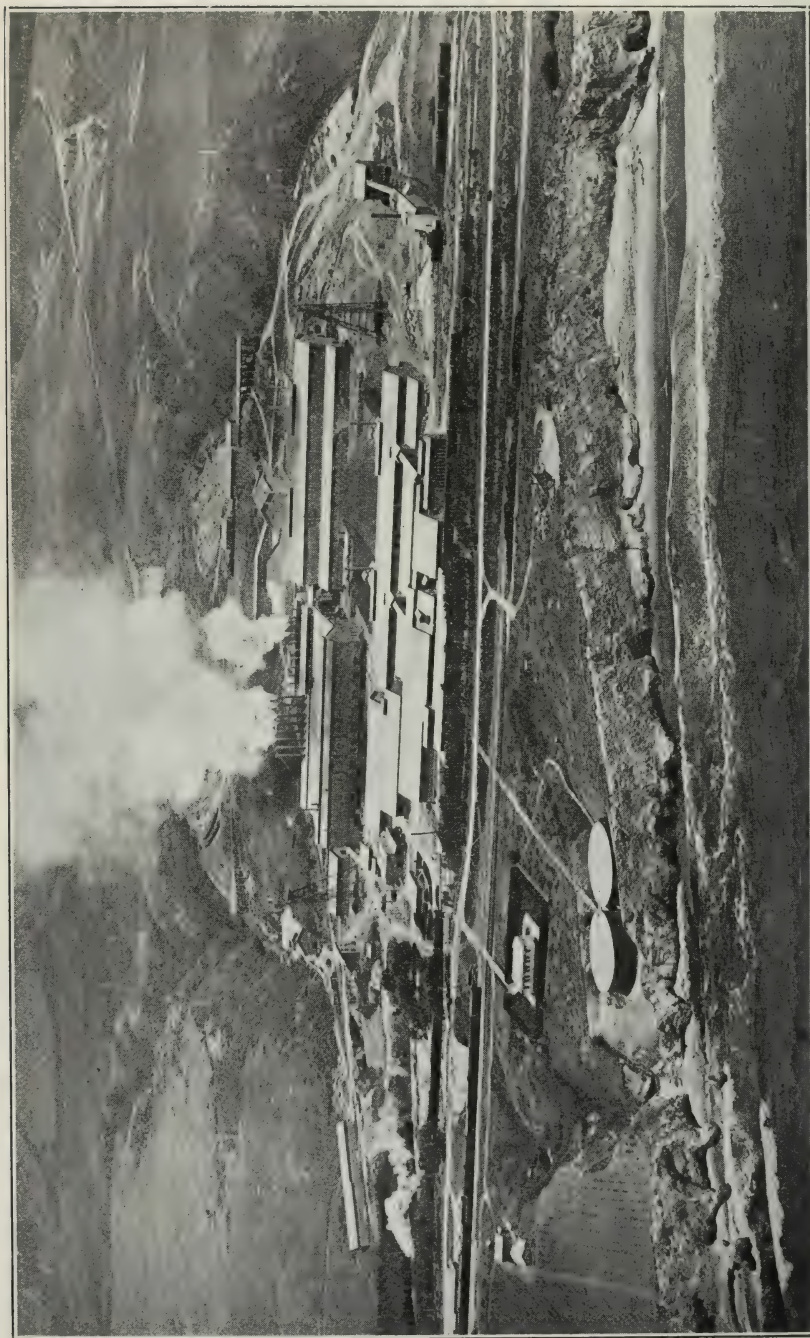
California now has ten operating portland cement mills, one partly constructed mill upon which work has temporarily ceased, and another plant which is nearing completion and which will probably start production during 1926.

Of these, the largest single cement mill is in Santa Cruz County.

Santa Cruz Portland Cement Company; home office, Crocker Building, San Francisco; plant at Davenport, Santa Cruz County; officers, George J. Cameron, president; W. K. Berry, secretary; George R. Gay, manager; Fred Davis, plant superintendent.

This company's mill site is at Davenport near the northern terminus of the marine terrace which borders the ocean northwesterly from Santa Cruz for 15 miles. The plant is within sound of the surf about one-half mile north of San Vicente Creek Canyon and 13 miles from Santa Cruz. A branch line of the Southern Pacific Railroad

¹ U. S. Geol. Survey Mineral Resources, 1905, p. 1188.



PLANT OF SANTA CRUZ PORTLAND CEMENT COMPANY, DAVENPORT, CALIFORNIA.

Airplane photo by courtesy of the company.



A horizontal scale bar with tick marks at 0, 100, 200, and 300 feet. The numbers are placed above the bar.



from Santa Cruz serves it. A good paved highway closely parallels the railroad.

The first shipment of cement was made on May 17, 1907, since which time the company has been in continuous production, although not always at full capacity. The mill at present has a capacity of 10,000 barrels per day, and 350 men are on the pay roll. Electric power furnished by the Pacific Gas and Electric Company is used throughout, the connected load being 12,000 horsepower.

Limestone and a considerable portion of the clay used is obtained from the company quarry three miles up San Vicente Canyon. Additional clay is mined near Glendale and shipped to storage at the plant (see under Clay). The gypsum used comes from Nevada.

Additions to and changes in equipment and methods of operation, both at the mill and the quarry, have been adopted from time to time and some radical changes in the mill flow-sheet are now under way.

Additional equipment being installed will increase the mill capacity to 14,000 barrels per day. It will also permit an intimate and uniform mixture of the raw materials closely approaching or equalling that obtained in 'wet-process mills,' at the same time preserving the advantageous feature of the 'dry-process.'

The accompanying plan shows the general layout of the mill and equipment approximately as it will appear when alterations are completed, but it does not indicate the conveyor distributing system with its automatic weighing and mixture control arrangement and many other details. A low-pressure oil-burning system has replaced the high-pressure system formerly used. Hammer-screens, rolls and Hardinge mills have been added, in part replacing tube and ball mills.

The most important change at the quarry has been the abandonment of the original open quarry, worked by a single bench with steam-shovel loading, and the substitution of a new method of quarry operation designed and put in operation by Mr. Robert A. Kinzie, Mining Engineer, San Francisco.

The quarry and new method of working have been recently described in great detail in an illustrated article by George J. Young,¹ of which the following is a brief résumé.

The plan of working is a combination of glory holes, transfer raises, bulldozing chambers, chute loading and adit transportation. Since it was put into operation, over 500,000 tons of limestone have been delivered to the mill at a greatly reduced cost.

Operations are divided into stripping and quarrying. Stripping is done by steam shovel mounted on caterpillar tractors. The overburden is loaded into dump cars which are hauled in trains by a 20-ton steam locomotive to the dump. Three trains are in operation. Stripping is carried on sufficiently in advance to provide four years' supply of limestone. About thirty men are employed on the stripping crew.

On the quarry loading-out level two haulage drifts 9 by 12 feet on 60-foot centers extend along the principal axis of the deposit. Between these drifts at an elevation of 30 feet above the haulage level are a series of bulldozing chambers. Each chamber is 80 feet in length, and 50 feet in width. Their bottom is hopped out and connected to six

¹ Young, George J., Mining Limestone by Glory Holes in California, Engineering and Mining Journal-Press, Vol. 120, No. 7, August 15, 1925.

chute raises, three on each side. The chute raises, 6 by 8 feet in section, are driven at an angle of 50° with the bottom angle reduced to 37° and are fitted with underswung arc-gates. Thirty-three chutes are now available for loading. The haulage cars have steel bodies of 253-cubic feet capacity and are loaded to 12 tons. Three storage-battery locomotives are used for handling the cars in the drifts. They are handled in 8 to 10-car trains, both locomotives and cars being equipped with air brakes. The cars are made up in 200-ton trains in the yard at the quarry and ten trains per day are dispatched to the mill. Two 18-ton trolley-type electric locomotives are used for this work. Cars are dumped at the plant by a revolving tipple operated by compressed air.

From the top of each bulldozing chamber, referred to previously, a raise 10 by 11 feet square extends to the floor of the quarry. These raises establish the position of the surface glory holes. They are spaced 120 feet apart. Six raises have so far been extended to the quarry level. A glory hole is started by coning out the top of the raise to an angle of approximately 60° . During the coning out the broken rock in the raises is drawn down to expose the benches that are cut. Bulldozing is done with 40% powder in the bulldozing chamber whenever necessary through man-way raises, intermediate and sub-drifts. The cones, transfer raises, bulldozing chambers and chute raises are kept full of rock, the subsidence being gradual as the chutes are drawn. The capacity of a bulldozing chamber, raise and cone is about 5000 tons of broken rock, so there is considerable storage in addition to the broken rock in the pit. No serious hang-ups in the system have occurred even though one raise is drawing from a portion of the quarry that contains a good deal of clay mixed with the limestone.

A total of 75 men are employed at the quarry, including 30 in the stripping crew, for the present output of 2000 tons per day, which is equivalent to 27 tons output per man-shift.

The deposit extends over a width of 1200 feet for approximately three-quarters of a mile. It is an homogeneous close-grained light gray to white limestone free from magnesium carbonate. The area was diamond-drilled prior to the adoption of the glory-hole method and its extent found to be greater than anticipated, the tonnage being sufficient for a long period of operation.

CLAY.

Up to the present time the clay deposits in Santa Cruz County have been only superficially studied. Common clays, suitable for brickmaking and similar uses, are known to occur along San Lorenzo River and at other points and there is no doubt a plentiful supply of such low-grade clays. In the early nineties two brickyards were in operation near Santa Cruz, but these have long since been dismantled. Deposits of cream-colored pottery clay are also said to be known, but their exact locality was not divulged to the writer.¹

The only clay now produced in the county is that used by the Santa Cruz Portland Cement Company. It is mined near Tank Siding, 1.8

¹ Since the above was written the Mining Bureau has been informed that there is a "fine large deposit of pottery clay" on the property of J. B. King, Skyland; P. O. Wrights Station. This information was received too late for confirmation by personal examination.

miles southwest of Glenwood and at their limestone quarry, and used in the manufacture of cement at the company's plant at Davenport. Operations at Tank Siding are not carried on continuously; their annual requirements being taken out during the most favorable season by a few months' intensive mining operations.

Further data relative to the clays of this county will be contained in a new bulletin of the State Mining Bureau on the clay industry of California, now in course of preparation by W. F. Dietrich, Ceramic Engineer.

Bibl: State Mineralogist's Reports X, p. 625; XII, p. 383; XIII, p. 619; XVII, p. 234; Preliminary Report No. 7, p. 97.

COAL.

Several small veins of lignite coal have been found in Santa Cruz County. Prospecting for coal north of Watsonville was active during the early eighties and a little coal was mined on Corralitos Creek about that time. During the past year one of these veins in the vicinity of Corralitos was reopened and the coal sold for domestic purposes in Santa Cruz.

As much of the coal in California is lignite, or of such low grade that it can not be used to advantage as a steam coal, investigations have been under way in various quarters looking to a more economical method of utilizing the deposits. Research has taken the form of its possible utilization in the direct production of sponge iron and steel in the electric furnace. Others have investigated the low-temperature distillation process with the production of a semi-coke briquette, said to be an ideal smokeless domestic fuel, and various by-products. Experiments which give promise of success have been made to purify lignites and low-grade coals by some process such as the Trent method, which consists in agitating together powdered coal, water and oil. This produces a partly de-ashed plastic fuel called 'amalgam,' the oil selecting the coal particles and largely excluding the water and ash. In one experiment on a California lignite, the ash reduction amounted to 26.8%, the combustible recovery was 95%, and the sulphur reduction was 12% after treatment. Others have considered the manufacture of calcium carbide (CaC_2) from lime and lignite coal. Still other investigators have undertaken to show how these coals may be used in powdered form, either alone or with oil in 'colloidal' fuels; to make them into briquettes without the use of an expensive binder; to manufacture producers gas from them; and to obtain for commercial use their other constituents, including ammonia, benzol, toluol, solvents, drugs, oils, and other coal tar products.

One of the newer developments is a process for extracting oil from coal, in which powdered coal held in oil is subjected to high temperature with agitation in an atmosphere of hydrogen. Under these conditions it is reported that 10 to 45 per cent of the coal will become soluble. After removal of the carrying oil there remains a pitch of asphalt-like product possibly capable of further hydrogenation.

These various possibilities lend additional interest to the development of any coal beds within the county in addition to the ordinary use of the coal for domestic fuel.

Look Coal Mine. This property comprises 10 acres situated on Redwood Canyon in Sec. 30, T. 10 S., R. 2 E. Owner, C. R. Look, 44 Clay Street, Santa Cruz. There is a good road to the mine from Corralitos, the nearest town. It is approximately 9 miles from the mine to either Watsonville or Aptos, the nearest railroad points, and 19 miles to Santa Cruz. Elevation at the mine, 800 feet. The surface rises steeply from Redwood Creek toward the west, and is thickly covered with redwood, tanbark oak and brush.

The existence of a vein of coal on this property and croppings on adjacent tracts have been known for many years, but were considered of little importance. The showing here was the most prominent and the present owner acquired the land about ten years ago, but only started work on the coal vein in 1924. Development was continued in 1925, the old adits being cleaned out and extended. A raise is now being put up on the vein from the lower to the upper adit. Between 75 and

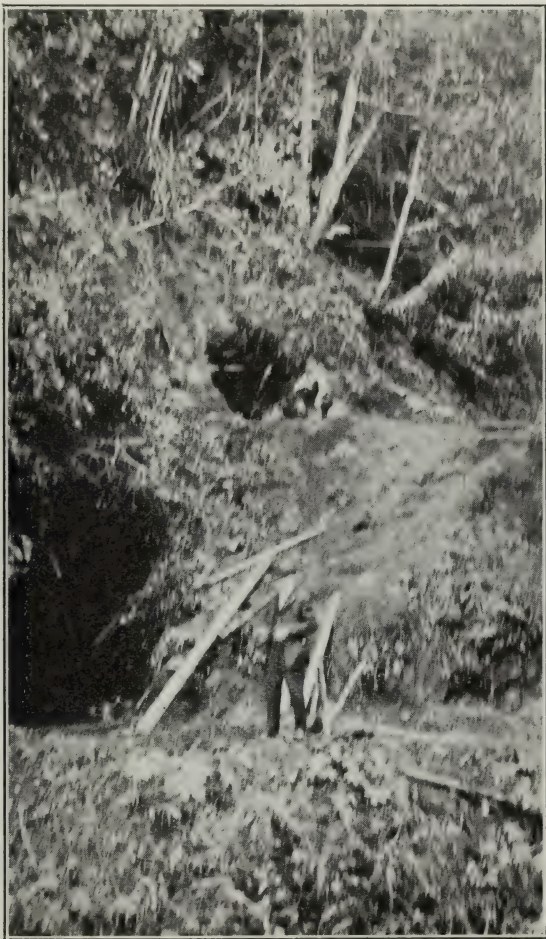


Mouth of upper adit showing footwall of vein dipping about 45° , at right of wheelbarrow, Look Coal Mine, Santa Cruz County.

90 tons of coal removed in doing this work was sold in Santa Cruz and vicinity. One man is employed.

The vein appears to strike east-west and dips 45° south, but is exposed only near the creek level where the canyon cuts across it. Both adits are driven in on the vein and run almost due west. The lower one is in 200 feet and the upper one, about 20 feet higher and 20 feet northerly, is in 100 feet. Both roof and floor are sandstone. The vein is fairly regular but varies in width from three to four feet. The coal is a fair grade of lignite, black in color, but showing some laminations, and inclined to slack on exposure, though this slacking is not pronounced if the coal is protected from the weather. It has not proved to be a satisfactory fuel in an open fireplace, but the writer saw it burning freely with no soot in an ordinary kitchen range, giving a bright hot fire. The ash is fine, reddish gray in color, but may amount to as much as 20 per cent. No analyses have been made. The owner states that where the coal has been burned in a stove with a grate and good draft, users report it very satisfactory.

There are indications of some parallel veins nearby, but no work has been done on them. On another ranch, about one-quarter mile east of the Look workings and approximately on the strike of this vein, there is another exposure in a road cut. This may be an extension of the Look vein, but at the latter point the dip is exactly opposite, being about 45° north. Possibly this is only a localized fold or break-over. No work has been done here.



Upper and lower adits on coal vein, Look Coal Mine,
Santa Cruz County.

Leonard Ranch Coal Deposit. A vein of lignite from 6 to 18 inches in thickness, lying approximately horizontal between sandstone walls, is exposed in the bluffs facing the ocean beach on the P. M. Leonard Ranch, two miles southeast of Aptos. The property is under lease as a ranch to Bontadelli and Son. In a small creek some distance back from the beach a hole about six feet deep shows 18 inches of the coal. It is black in color but laminated and friable due no doubt, in part to

long exposure, as no fresh material was exposed. The bed is thicker here than on the beach, indicating that still farther inland a workable vein might be developed.

GOLD.

Gold occurs in Santa Cruz County in auriferous black sand deposits, as placer deposits in a number of creeks and gulches on the sides of Ben Lomond Mountain, and in small quartz seams on Ben Lomond Mountain. During the eighties there was considerable activity both in working the black sand deposits near San Andres and the placers and veins in the vicinity of Felton. The principal placers were on Wardell Creek, Major Creek and Gold Gulch. Colors of gold are not difficult to obtain in the gravels along Gold Gulch and some placer mining was done here as late as 1920. Former operations are described in early reports of the State Mineralogist and in the History of Santa Cruz County, by Harrison.

The industry, if it could ever have been called one, gradually diminished and it is now a matter of history, about the only reminder being a large sign Gold Gulch Drug Store over a new building on the highway to Felton, near the site of some of the early workings. The larger land holdings in this vicinity are being subdivided for summer homesites and residence purposes and it is doubtful if any tracts would be sold or leased for mining purposes.

The black sand deposit being worked near Aptos by the Triumph Steel Company for its magnetite, ilmenite and chromite content is stated by this company to carry about 20 cents per ton in gold, but so far no effort has been made to recover it. See under Iron and Black Sand.

Bibl: State Mineralogist's Reports VIII, pp. 550-553; X, pp. 622-624; XII, pp. 243-244; XVII, pp. 235-236. History of Santa Cruz County, Harrison, p. 203.

GRANITE.

Granite has been quarried from Ben Lomond Mountain in the past. The rock, which is classified as quartz diorite, is a fair building material but is not being used at present.

There is a deposit of granite on Branciforte Creek in Sec. 29, T. 10 S., R. 1 W., which is said to present a face 700 feet high, from which large blocks could be easily quarried for rip-rap or similar use. The rock is reported to be of excellent quality, and transportation would not be difficult. It is undeveloped.

IRON.

Triumph Steel Company. This company utilizes the black sand (magnetite) accumulated on the ocean beach, for producing sponge iron, alloy steel and briquetted magnetite. D. M. Crist, president; J. Harris Mackenzie, secretary; L. H. Stowell, plant superintendent. Home office, 112 Market Street, San Francisco; plant, Box 252, R. F. D. No. 3, Watsonville, Cal.

The property of the Triumph Steel Company is situated at sea level two miles southeast of Aptos. Trains, however, also stop at the plant, the station being called Cristo.

Research and experimental work on the black sands has been carried on here for several years. Originally a red iron-oxide paint pigment was produced. Later the plant was expanded and the direct production of sponge iron from magnetite begun.

The company owns a site of five acres and $1\frac{3}{4}$ miles of adjacent beach. The process of reducing the magnetite is patented and much of the apparatus in the unit in operation is of original design and manufacture.

The gray-black beach sand is taken by a drag-line scraper, operated by an electric hoist and delivered to a bin feeding an elevator. The elevator delivers the sand through a screw feeder to a rotary oil or gas-fired kiln which is used as a drier. After passing through this rotary, the thoroughly dry sand is run to another elevator which discharges into a revolving screen at the top of the plant. This screen, which is about 12-mesh, removes all pieces of shell and coarse gravel which go to the dump. The fine sand discharges to a hopper feeding the



Plant of Triumph Steel Company, utilizing black sand, near Aptos, Santa Cruz County.

special design magnetic separator. This machine consists of a series of horizontal troughs mounted on a frame standing at an angle of about 80° from the horizontal and reaching from the lower floor to an elevation of about 40 feet. The sand from the hopper at the top is distributed in a thin film over the top trough and falls by gravity from top to bottom of the separator. In dropping from one trough to another, it passes over magnetic fields of various intensities designed to remove the separate constituents. Practically all of the magnetite is obtained in the first four troughs. As the sand flows over these, the circuit to the electro-magnets is automatically broken three times per second, pulling out and dropping the magnetite into a compartment. As the sand continues to cascade over the remaining sectors the ilmenite and chromite are segregated by regulation of the magnetic fields, each going to separate bins. The quartz garnet and other minerals constitute the tailing which is discharged.

Either pure magnetite, or a combination of magnetite with ilmenite or chromite as desired, is then elevated and fed to a special revolving electric-heated muck-bar tube or kiln, approximately 3 feet in diameter and 35 feet in length. The lining of this tube has nicrome heating elements imbedded, connection being made by two annular copper bands at each end, which revolve with the tube and dip in mercury troughs. Crude oil is sprayed into the feed end of the hot tube as the magnetite passes through it. The oil does not burn but is immediately gassified, the gasses reducing the iron oxide to a metallic condition as sponge iron. The sponge iron is discharged at the lower end into a briquetting press, which delivers the muck-bar billets ready for the market. Gasses from the muck-bar tube are drawn off and go to a dephlegmator, which extracts crude oil from them, and delivers an excess of CO gas, for use under the boilers or dryer.

A large amount of direct electric current is used, four days being required to bring the muck-bar tube up to operating temperature after a shut-down. All electricity is generated at the plant which is equipped with a 500-h.p. Babcock and Wilcox boiler and generators having a total of 2000 horsepower. Only a portion of the latter are used in this unit. It is said that no other process will directly produce ferro-titanium.

The plant includes a machine shop, laboratory and housing facilities. Twenty-one men are employed; the full capacity of the present unit being 50 tons of muck-bar per day. An electric furnace for the production of alloy-steel is contemplated.

The development of this direct iron-reduction process has required considerable investment in plant and research. Metallurgically it appears to be workable, but its commercial and economic success has not as yet been definitely proved.

LIME.

The burning of lime is one of the earliest industries established in Santa Cruz County, the first lime kiln having been built in 1851 by I. E. Davis and A. P. Jordan. This afterward became the property of Henry Cowell, and the old pot kilns may still be seen on the Cowell Ranch alongside the road from the limestone quarry to their present kilns at Rincon.

Henry Cowell Lime and Cement Company. S. H. Cowell, president; W. H. George, secretary; home office, 2 Market Street, San Francisco. The Cowell quarry is two miles northwest of Santa Cruz and one mile up the canyon from the old quarry first worked by Davis and Jordan and later by Henry Cowell. Limestone outcrops in this canyon in many places. The rock is both coarsely-crystalline and fine-grained, white to bluish-white in color; the coarse-crystalline variety being the most abundant.

The limestone is quarried by hand drilling and shooting down with giant powder. It is all trucked from the quarry 1.9 miles to the kilns at Rincon Station on the Southern Pacific railroad. Formerly the coarse-crystalline limestone was burned in three pot kilns near the ranch house and the dense and fine-grained variety in four 34-foot Standard continuous kilns at Rincon. In 1920 three new pot kilns were added to the Rincon plant and the ones near the ranch house aban-

done. The Standard continuous kilns did not work well except on the dense fine-grained rock. This variety required a greater heat for complete calcination, and the use of the continuous kilns also necessitated selective mining of the limestone to provide a suitable feed. For these reasons they are not now used and all the limestone is now burned at the Rincon plant in three pot kilns. Each kiln has a capacity of 1600 barrels and is provided with four draw doors and four burners. Fuel oil is used with steam atomization. It requires from 4 to 4½ days to burn a charge, 36 to 48 hours for cooling and 2 days to draw the burned lime. The barrels in which the lime is packed are made in a cooper shop at the Rincon plant. Twenty-five men are employed at the kilns in addition to several at the Cowell quarry.

I. X. L. Quarry. This quarry, also owned by the company, is situated 2½ miles northwest of Felton and one-half mile north of the



View showing one-half of pot lime kiln from firing and draw-door floor, Henry Cowell Lime and Cement Company's Plant, Rincon, Santa Cruz County.

Holmes Lime and Cement Company's quarry. There are three pot kilns on the property. No limestone has been quarried or burned here for the past seven years.

Holmes Lime and Cement Company. W. E. Buck, president; W. J. Feary, secretary. Home office No. 2, Pine Street, San Francisco. George N. Ley, plant superintendent, Box 7, Felton, California. This company owns and operates a limestone quarry two miles northwest of Felton. The limestone is exposed along the strike northwestward from the base to the top of the mountains, about 1000 feet. At the present time the quarry is opened on three faces. There is considerable overburden which is hauled off in dump carts. Air-drills are used, an electric motor and compressor being installed at the workings. The limestone is trammed from the quarry to the kilns and hydrating plant in 8-ton cars which are hauled back with horses. The rock is a white crystallized limestone, both coarse and fine-grained. At the plant which is situated below the quarry near the town of Felton five

pot kilns are in use; one of 1000 barrels capacity and four of 500 barrels. There are also two patented continuous kilns not in use. Oil with steam atomization is used for burning. In addition to the burned lime, the plant is equipped with a Clyde hydrator having a capacity of 25 tons of hydrate per day. The hydrate is bagged by a Bates valve-bag sacker. The lime is barreled at the kilns in barrels made on the property.

Thirty-two men are employed; twelve at the quarry and the others at the kilns and hydrating plant. The quarry is an old one and has been operated over 45 years.

LIMESTONE.

Miller Quarry. This property, formerly known as the *Thurber Quarry*, contains 23 acres, situated two miles northwest of Santa Cruz, adjacent to holdings of the Pacific Limestone Products Company. The rock varies from a coarsely-crystalline white or bluish-white limestone to a finer-grained hard siliceous limerock. There is a small crushing plant containing a 9 x 14-inch Blake crusher for preparing the stone for macadam and concrete work, the only purposes for which it is used. The quarry has been worked up to the property line on one side and, as there is increasing overburden on the present face, the owner is considering starting a lower bench near water level. The quarry is worked in a small way only, an average of two men being employed the year round. Owner, W. E. Miller, 81 Church Street, Santa Cruz.

Pacific Limestone Products Company. Home office, plant and quarry at Santa Cruz; sales office, Postal Telegraph Building, San Francisco. Officers: F. W. Johnson, president; D. L. Martin, vice president; W. C. Johnson, secretary. This company was organized in 1923 and took over the old Caplatzi Quarry which had been operated on a small scale by former owners for many years. Since the property was taken over by the Pacific Limestone Products Company, the number of raw limestone products prepared for specific purposes has been greatly increased and they are now being used for terrazzo, stucco dash, chicken grit, roofing grit, commercial fillers, glass manufacture, motor sand, concrete brick, cattle lime, poultry lime, fertilizer, macadam, and other uses. By the installation of additional equipment at the plant and sales promotion work carried on among prospective users of raw limestone products, the company has succeeded in quadrupling the output of the quarry in the past two years.

The property comprises $14\frac{1}{2}$ acres located at the end of Spring Street, Santa Cruz, two miles northwest of the Southern Pacific depot, at an elevation of 250 feet. The deposit is a limestone rock, medium hard with very fine to very coarse crystals. The rock is shattered and broken in large masses and is bluish-white in color. The average face is 52 feet high with an overburden of from 2 to 8 feet of soil and red clay. The overburden is removed by shooting with black powder to the floor of the quarry, or else it is trapped in a 10-yard bin chute. If the overburden is shot to the quarry floor, it is picked up by a Haiss loader and loaded into wagons or trucks.

A good deal of this overburden is sold for fill material. All that is not sold is hauled to a waste dump.

Rock is blasted down with 10 to 14-foot toe holes averaging 8 to 10 feet from the face with 40 per cent L. F. Extra Giant $\frac{3}{4}$ x 8 dynamite. Due to the many vertical seams a large amount of the rock is broken down without drilling. Air from a 6 x 7-inch single-stage Sullivan compressor furnishes power for a Sullivan 'Junior' rotary jack hammer. Pieces over 24 inches are plug shot. All rock is broken with 16-pound rock hammers to sizes less than 6 inches.

Because of mixed impurities of magnesium and silica all rock is hand-picked for its color, crystals and impurities. The piles of 6-inch rock are hauled to a No. 4 Austin gyratory crusher in $1\frac{1}{2}$ -yard one-horse dump carts or in one-ton Ford trucks. This crusher is about 500 feet from the present quarry face. Three men are used to fill the carts, and there is a driver for every two carts. While the driver is hauling one cart to the crusher, the other cart is being filled.

The Austin crusher reduces the stone to $2\frac{1}{2}$ inches or smaller. This stone is then elevated by a bucket conveyor a distance of 50 feet to three gravity screens. The bucket elevator has 9 x 12-inch buckets spaced 12-inch centers. The screens separate out $\frac{1}{4}$, $\frac{1}{8}$, and from $\frac{1}{8}$ to 30-mesh sizes. The dust, if limestone is being crushed, drops into a bin directly below the screens and is sold as fertilizer. The $\frac{1}{4}$ and $\frac{1}{8}$ -inch sizes drop to bins below the screens and in front of a No. 2 Williams hammer mill, or if desired, directly into another elevator that carries them to the grit screens. Stone larger than $\frac{1}{4}$ -inch goes to a storage bin. Stone is drawn from this storage bin and conveyed horizontally 20 feet to a 30-inch by 14-foot revolving screen. This screen has its cloth in four sections, and separations are made as the trade demands. Flux stone is made in two sizes from $\frac{1}{2}$ to $1\frac{1}{2}$ inches and from $1\frac{1}{2}$ to $2\frac{1}{2}$ inches. The oversize from this screen drops to a No. 2 Eureka jaw crusher. The discharge from this crusher is elevated 15 feet to a 30-inch by 6-foot revolving screen. This screen removes the dust and smaller sized crushed rock for special demands.

The discharge from the Williams mill is elevated 45 feet to a double cloth 30-inch by 10-foot revolving screen. This screen separates out four sizes. The tailings fall through a chute to a storage bin for recrushing. Each size is separated out from the screen and drops to separate storage bins. The separation from the outer screen drops to a No. 9 Rotex screen. The oversize from the Rotex screen passes to a storage bin directly over a No. 2 Williams pulverizing mill which grinds the material to fertilizer limestone. The discharge from this Williams mill is elevated 35 feet and passes over a gravity screen that separates out the oversize. The oversize is returned to the Williams mill. All fertilizer is ground to pass 22 mesh. The grits are weighed by a Howe automatic net bagger. Fertilizer is weighed on standard grain scales. All products are bagged in 100-pound lots.

The layout is simple and so arranged that the special products can be produced without any difficulty.

The plant operates the entire year. Sixteen men constitute the average working force. Four men are employed in the mill and sacking department, four men handle all hauling, and the rest are used in

the quarry. During rush periods the force has been increased to 36 men.

Bibl: State Mineralogist's Report XII, p. 395; XIII, p. 631; XVII, p. 237. Pit and Quarry, Vol. 10, No. 5, June 1, 1925, pp. 55-58.

MINERAL WATER.

Although several small mineral springs occur singly and in groups within Santa Cruz County, no mineral water is bottled or commercially produced. There is little improvement at any locality except St. Francis Springs which was formerly a popular resort, long known as Chittenden Springs and later as El Pajaro Springs, where hotel accommodations were available.

Hinns Sulphur Spring. This is a small unimproved cold sulphur spring, located near the top of Hinkley ridge about one mile east of Olive Springs.

A number of other small unnamed seepages or springs of mineralized water also occur west and northwest of Olive Springs.

Olive Springs. This picturesque property, which still remains practically in its natural state, comprises 100 acres, located on Hinkley Creek near its junction with Soquel Creek and extending to the top of the ridge between the two streams.

The property is in T. 10 S., R. 1 W., and varies in elevation from 300 feet at the camping ground to 1200 feet on the ridge. It is six miles north of Soquel with which it is connected by a good road. Owner, Elizabeth J. Corcoran, Box 81, Seabright, California.

Hinkley Creek flows through a deep canyon here, the walls of which stand nearly vertical. Seepages and springs occur at numerous points in the creek bed and from the sandstone formation, which forms the canyon walls. The rock is very soft in places and in process of decomposition.

Of probably a dozen springs on the property, five have been somewhat improved by constructing small concrete basins around them. These five are known as the 'White Sulphur,' 'Sulphur,' 'Sulphur and Iron,' 'Magnesium,' and 'Magnesium and Iron' Springs, but the names mean little. All are cold.

The so-called 'magnesium and iron' spring has a flow which more than fills to capacity a 2-inch open pipe line, with a fall of 100 feet or more in a few hundred yards, leading from it to the camp grounds.

No water is sold but visitors are permitted to carry away as much as they desire.

Analysis of the 'White Sulphur' spring water by G. A. Banks, M.D., Chemist:

Constituents in parts per million.

Reaction:

Primary salinity	29
Secondary salinity	2
Tertiary salinity	0
Primary alkalinity	0
Secondary alkalinity	62
Tertiary alkalinity	?

<i>Constituents</i>	<i>By weight</i>	<i>Reacting values</i>
Carbonate (CO_3)	390	12.98
Sulphate (SO_4)	234	4.80
Calcium Ca	180	9.00
Sodium Na	156	6.90
Phosphate (PO_4)	0	0.00
Chloride Cl	104	2.98
Magnesium Mg	86	6.92
Potassium K	2.5	.06
Total	1152.5	

Carbon dioxide (CO_2) present
 Hydrogen Sulphide (H_2S) 8.2

The soft decomposed sandstone in the vicinity of the springs has been investigated with a view to utilizing it in the preparation of a cleansing compound or soap, as it is claimed to have remarkable qualities as a 'chemical clay.' It has a soluble potash content, and a small plant was erected on the property during the war period for the production of potash. A steel leaching tank and parts of what appear to be a concrete calcining furnace or evaporator remain on the ground, but as this work was carried on before the present owner took possession, the results obtained are not known. It is said that some potash was produced.

According to an analysis by E. W. Rice, of Santa Cruz, the decomposed sandstone has the following composition:

	<i>Per cent</i>
SiO_2 Silica	72.680
Fe_2O_3 Iron Oxide	.755
Al_2O_3 Aluminum Oxide	13.575
CaO Lime	4.305
MgO Magnesia	0.325
K_2O Potash	3.265
Na_2O Soda	1.925
Loss on ignition	3.125

St. Francis Springs. This property contains 37 acres located on the banks of Pajaro River at Chittenden Station. At least 12 cool, strongly-sulphuretted springs issue at this locality along a sloping bank near the river. The springs were long known locally as Chittenden Springs. In 1909 they were improved and opened to the public as Shale Sulphur Springs. Later the name was changed to El Pajaro Springs.

The property is now owned by the Franciscan Fathers, 133 Golden Gate Avenue, San Francisco, and is called St. Francis Springs. It has reverted to private use and probably will never again be opened as a public resort. The conversion of the buildings into a seminary is contemplated.

Bibl: State Mineralogist's Reports VIII, p. 555; XIII, p. 519; XVII, pp. 239-241. U. S. Geol. Survey Water Supply Paper 338, pp. 272, 274-276.

MOLDING SAND.

During the past year molding sand has been added to the list of commercial minerals produced in Santa Cruz County.

Daniels Transfer Company, 23 Front Street, Santa Cruz, is producing this material from a deposit at Twin Lakes. It is being used in local foundries.

This information was obtained after the completion of field work in the county and subsequent to the collection of samples of California molding sands by the State Mining Bureau for testing by the American Foundrymen's Association, so that, as yet the deposit has not been visited nor the sand tested to determine its particular characteristics and adaptability for different foundry purposes.

PEAT.

Peat is said to occur in Santa Cruz County near Felton. Small deposits may possibly be found in the vicinity of Watsonville also, as the log of an artesian well bored near the outskirts of the town showed 12 feet of peaty bog underlain by blue clay. There are probably no extensive deposits.

PETROLEUM.

There has been no commercial production of petroleum in Santa Cruz County, although small seepages of crude oil have been found and a number of wells drilled. According to J. C. Branner, J. F. Newsom and Ralph Arnold,¹ who reported only upon that portion of the county within the Santa Cruz quadrangle, "apparently the most promising locality for prospecting for oil is that along the coast west and southwest from the outcropping bituminous rock beds, since those beds pass down under overlying shale in that region. Wells drilled here, however, failed to find oil, and it is supposed that the oil which must formerly have existed in the sandstones of the region has been drained off through large fractures which extended from the surface of the shale down to the underlying sandstone. Many sandstone dykes, some of them of large size, occur along the coast in this region. These were formed from the underlying oil-bearing sandstones and the larger ones probably represent the channels through which the oil from the underlying strata escaped."

The geology and oil possibilities of the county are further discussed by Vanderleek,² who says, "In the area around Ben Lomond Mountain, running from Little Basin to the town of Santa Cruz, the formations consist of granitic rocks, together with areas of ancient crystalline schists. In the region to the north of this crystalline area there are outcrops of the San Lorenzo formations, the Vaqueros sandstone and the diatomaceous shale of the Monterey. These have been all sharply folded and faulted. The Monterey contains numerous seepages, but there is an almost total lack of an overlying formation which could act as a reservoir. This, together with the unfavorable structural conditions, make the possibility of obtaining oil in paying quantities in this area remote. In some cases, by reason of faulting, the oil has migrated from the Monterey into the underlying beds of the Vaqueros and San Lorenzo. It is probable that wells drilled in this area in either the Monterey, or the underlying Tertiary beds will encounter

¹ Geology of the Santa Cruz Quadrangle, U. S. Geol. Survey Folio No. 163, 1910.

² Vanderleek, Lawrence, Petroleum Resources of California, State Mining Bur. Bull. No. 89, 1921, (out of print).

small showings of oil, but not of sufficient size to be of commercial importance.

"In the area between Ben Lomond Mountain and the coast, the Vaqueros and Monterey lie in a monocline, dipping about 25° to the southwest. The Monterey is heavily bituminized and has been extensively quarried for asphaltum.

"The remainder of the county, which embraces the district lying between Santa Cruz and Watsonville and southwest of the Santa Cruz Mountains, may be likened to a coastal plain. In the country north of Aptos this likeness is not generally apparent, as the hills frequently rise to a height of 1500 to 1800 feet. Between Aptos and Watsonville, however, the county is characterized by low rolling hills, varying in elevation from 100 to 500 feet. The northeast boundary is marked by the steep escarpment of the west side of the Santa Cruz Mountains, formed by the San Andreas fault. The greater portion of the district is covered by loose incoherent sands and clay, varying in color from yellow to brown and having no distinctive strike or dip. The age is not definitely known, but very probably they belong to the Merced formation (upper Pliocene). With the exception of an area about three miles northeast of Watsonville (which will be discussed below) no distinctive structure could be made out in these beds. Near the town of Santa Cruz, the Monterey shale apparently dips under the Merced beds and very probably it underlies this entire area. Between the San Andreas fault and the Santa Clara County line, is an area of Monterey shale, referred to in the article on Santa Clara County. The shale apparently lies in a synclinal trough; the eastern limb resting on the Franciscan; the axis of the syncline approximately coinciding with the county line and the west limb is faulted against the Merced beds by the San Andreas fault.

"On the Mount Madonna road, about four miles north of Watsonville and about one-half mile south of the Casserly school, is the axis of a small anticline in the Merced beds, the west limb of which is sharply compressed against the Monterey shales by the San Andreas fault. It is in this area that the indications of oil occur. On the Webb Ranch, it is reported that two shallow wells were drilled and obtained gas. In the canyon just back of the ranch house there is apparently a dry seepage of black oil. On the Hughes Ranch, one well was drilled up the canyon just back of the house. A depth of 700 feet was reached and considerable gas was encountered. At the present time (1921) the Cymric Oil Company is drilling a well at this location. This area may be considered as worthy of being tested. As regards the remainder of the area under discussion it is worthy of being thoroughly investigated for structure before being condemned. It is apparently underlain by bituminous shales of the Monterey and should detailed mapping reveal any favorable structure in the Merced beds, the locality would be worth testing."

The following data regarding prospect wells drilled within the county from 1914 to 1924, inclusive, are from records compiled by the State Oil and Gas Supervisor.¹

¹ Bush, R. D., Result of Wildcat Drilling in California, 1914-1924, Summary of Operations, California Oil Fields, Vol. 11, No. 1, July 1925.

Company	Well	Sec.	Location		Date	
			T.	R.	Started	Depth
Cymric Oil Company-----	1	14	11S	2E	1921	1500
Danish Oil and Development Company--	1	22	11S	2W	1922	1200
Danish Oil and Development Company--	2	22	11S	2W	1923	2400
Rhoads and Schmitt-----	1	17	9S	1W	1918	1000
Santa Cruz Laveaga Trust Oil Co.-----	1	5	11S	1W	1924	800
United Royalties Company-----	1		Hughes Tract		1924	----

The Swanton Improvement Company's well No. 1 in Sec. 23, T. 11 S., R. 2 W., was reported ready to drill subsequent to the above compilation.

POTASH.

There is a small annual production of sulphate of potash, which is recovered from the flue dust and gases from the kilns at the plant of the Santa Cruz Portland Cement Company at Davenport. During the war period there was also reported to have been some potash produced from a deposit of decomposed sandstone containing soda and potash feldspar located at Olive Springs (see under Mineral Water).

STONE INDUSTRY.

(CRUSHED ROCK, SAND AND GRAVEL.)

Except at the plant of the Pacific Limestone Co., where a small tonnage of a siliceous dike rock is sorted out for macadam and concrete, there are no commercial rock-crushing plants within the county; also at the Miller Quarry (see under Lime and Limestone) a small amount of limestone is crushed for macadam and concrete. The latter output is used by the owner on road and street contract work. There is but a single producer of washed and sized sand and gravel; all other material of this kind produced being 'bank run.'

Roach Sand and Gravel Plant. Owner, E. S. Roach, 67 Peyton Street, Santa Cruz. This plant is situated on the east bank of San Lorenzo River just north of Soquel avenue bridge in Santa Cruz. The property contains $1\frac{1}{2}$ acres. Sand and gravel are recovered from the stream bed by pumping. An 8-inch Byron Jackson centrifugal pump, with 20-foot suction pipe mounted on a barge anchored in the stream, pumps the material against a 40-foot head to a trommel screen at the top of the plant. The pump discharge-line is 8 inches in diameter and at the present time the point of discharge is 450 feet from the barge. The pump is driven by a 75-h.p. electric motor and delivers 1800 to 2000 gallons of water, sand and gravel per minute. Another 15-h.p. motor drives the revolving screens.

Two sizes of sand are produced, a coarse sand for concrete and a fine sand for plaster. The coarse gravel is graded into $\frac{1}{2}$ -inch, 1-inch and 2-inch sizes. These are delivered to bunkers or stock piles. The plant has an average capacity of 200 yards per day. Water pumped with the material serves for washing. Short delays occasionally occur due to slides burying the pump suction, but as a rule little trouble is experienced. The barge and pump replace a drag-line excavator formerly used. Four men are employed.

Gibson Sand Pit. E. L. Gibson, 10 Leonard Street, Santa Cruz, owns and operates a sand pit at the mouth of a small lagoon on the beach between Santa Cruz and Capitola near Black Point. The beach

sand is excavated with a drag-line scraper, a Fordson tractor mounted on sills furnishing the power. The scraper dumps into a bunker from which trucks are loaded. The material is a quite uniform and fairly clean gray sand which is neither screened nor washed. About 120 yards per day can be taken out.

Taylor Sand Pit. R. S. Taylor, 246 Mission Street, Santa Cruz, has a bunker and drag-line scraper for excavating river sand from the bed of the San Lorenzo River. This pit is adjacent to the Roach Sand and



Roach Sand and Gravel Plant, on San Lorenzo River, at Santa Cruz, Santa Cruz County.

Gravel Plant near Soquel avenue bridge. It is operated intermittently according to demand.

In addition to the above, other firms and individuals occasionally dig sand and gravel from various points on the river or beach, loading direct to wagons or trucks. Among them are:

Owens Bros. Transfer and Storage Company, 256 Pacific Street, Santa Cruz.

Daniels Transfer Company, 23 Front Street, Santa Cruz.



LOS ANGELES FIELD DIVISION.

W. BURLING TUCKER, Mining Engineer.

On account of unfinished field work in Imperial and Riverside counties, publication of the report on the mines and mineral resources of these two counties has been postponed until the April, 1926, issue.



OIL FIELD DEVELOPMENT OPERATIONS.

By R. D. Bush, State Oil and Gas Supervisor.

From November 1, 1925, to and including January 30, 1926, the following new wells were reported as ready to drill:

Company	Sec.	Twp.	Range	Well No.	Field
ALAMEDA COUNTY:					
Thomas & Hammell	16	3	3	1	
FRESNO COUNTY:					
Mercantile Crude Oil Co.	6	20	15	7	Coalinga
Pacific Oil Co.	1	20	15	13	Coalinga
Pacific Oil Co.	13	20	14	36	Coalinga
Pacific Oil Co.	25	20	14	63	Coalinga
Pacific Oil Co.	25	20	14	64	Coalinga
Pacific Oil Co.	25	20	14	116	Coalinga
Pacific Oil Co.	7	20	15	122	Coalinga
Pacific Oil Co.	25	20	14	137	Coalinga
Paragon Oil Co.	17	19	15	18	Coalinga
Premier Oil Co.	24	20	14	30	Coalinga
Bald Mountain Drilling Co.	20	20	13	1	
KERN COUNTY:					
Belridge Oil Co.	33	28	21	131-X	Belridge
Devils Den Products Co.	24	25	18	2	Devils Den
Pacific Oil Co.	27	30	24	27	Elk Hills
Pacific Oil Co.	27	30	24	60	Elk Hills
Pacific Oil Co.	27	30	24	61	Elk Hills
Union Oil Co.	26	30	24	Elk Hills 13	Elk Hills
Union Oil Co.	26	30	24	Elk Hills 14	Elk Hills
George F. Getty, Inc.	32	27	27	Grimes 2	Kern River
George F. Getty, Inc.	14	28	27	Lehnhardt 3	Kern River
George F. Getty, Inc.	22	28	27	Tegeler 2	Kern River
Mendocino-Midway Oil Syn.	28	29	21	1	McKittrick
Oleo Fluo Co.	28	30	22	3	McKittrick
Safeway Oil Co.	20	30	22	2	McKittrick
Associated Oil Co.	20	31	23	3	Midway
Berry & Ewing	31	32	24	15	Midway
California Petroleum Corp.	34	32	24	Gordon 1	Midway
Calivada Oil Co.	34	32	24	3	Midway
E. & M. Oil Co.	10	31	22	16	Midway
E. & M. Oil Co.	10	31	22	17	Midway
H. F. Emme	24	31	22	1	Midway
H. F. Emme	24	31	22	2	Midway
H. F. Emme	24	31	22	3	Midway
H. F. Emme	24	31	22	4	Midway
King G. Gillette	21	31	22	1-A	Midway
King G. Gillette	21	31	22	1-B	Midway
King G. Gillette	21	31	22	2-A	Midway
Honolulu Consolidated Oil Co.	4	32	24	31	Midway
Honolulu Consolidated Oil Co.	4	32	24	33	Midway
Honolulu Consolidated Oil Co.	4	32	24	51	Midway
Honolulu Consolidated Oil Co.	4	32	24	52	Midway
Honolulu Consolidated Oil Co.	4	32	24	54	Midway
Honolulu Consolidated Oil Co.	8	32	24	58	Midway
R. B. Jackson & B. L. Todd	36	32	23	2	Midway
Midland Oilfields Co., Ltd.	34	31	24	Thornber B-4	Midway
North American Oil Cons.	30	21	24	31	Midway
North American Oil Cons.	30	21	24	33	Midway
Pacific Oil Co.	3	32	24	3	Midway
Pacific Oil Co.	33	31	24	16	Midway
Pacific Oil Co.	33	31	24	17	Midway
Pacific Oil Co.	33	31	24	49	Midway
Pacific Oil Co.	19	31	24	50	Midway
Pacific Oil Co.	19	31	24	52	Midway
Pacific Oil Co.	33	31	24	52	Midway
Pacific Oil Co.	19	31	24	57	Midway
Pacific Oil Co.	5	32	24	63	Midway
Pan American Petroleum Co.	19	31	23	3	Midway
The United Oil Co.	19	31	23	2-A	Midway

OIL FIELD DEVELOPMENT OPERATIONS—Continued.

Company	Sec.	Twp.	Range	Well No.	Field
KERN COUNTY—Continued.					
General Petroleum Corp.	32	12	23	Pacific 12	Sunset
King G. Gillette	12	11	23	1	Sunset
Julian Petroleum Corp.	32	12	23	1	Sunset
Midway Northern Oil Co.	32	12	23	12	Sunset
Pacific Oil Co.	30	12	23	86	Sunset
Little Ten Oil Co.	13	29	20	1	Temblor
Standard Oil Co.	27	11	20	Kern Co.	
				Lease No. 2 21	Wheeler Ridge
Standard Oil Co.	27	11	20	Kern Co.	
				Lease No. 2 22	Wheeler Ridge
King, Zier, Kettleman	13	25	19	1	
Main Oil Co.	28	27	24	2	
Milham Exploration Co.	10	28	23	Howard Sisson 1	
Red Rock Oil Co., Inc.	19	30	38	2	
A. G. Schwarz	25	29	26	1	
Sisson & Wisdom	35	29	20	1	
K. C. Wallace	7	25	20	1	
KINGS COUNTY:					
South Coalinga Oil Co.	35	24	19	Clarence G. Smith 1	
LOS ANGELES COUNTY:					
Associated Oil Co.	7	2	14	Vickers 28	Inglewood
Associated Oil Co.	7	2	14	Vickers 42	Inglewood
Associated Oil Co.	7	2	14	Vickers 43	Inglewood
Associated Oil Co.	7	2	14	Vickers 44	Inglewood
Pacific Oil Co.	8	2	14	19	Inglewood
Pacific Oil Co.	17	2	14	Baldwin 13	Inglewood
Pacific Oil Co.	17	2	14	Baldwin 14	Inglewood
Pacific Oil Co.	17	2	14	Baldwin 15	Inglewood
Pacific Oil Co.	17	2	14	Baldwin 23	Inglewood
Pacific Oil Co.	8	2	14	Baldwin 28	Inglewood
Pacific Oil Co.	17	2	14	Baldwin 35	Inglewood
Pacific Oil Co.	17	2	14	Baldwin 36	Inglewood
Shell Co.	8	2	14	Rindge 15	Inglewood
Standard Oil Co.	17	2	14	L.A. Invest. 1 34	Inglewood
Standard Oil Co.	17	2	14	L.A. Invest. 1 35	Inglewood
Standard Oil Co.	17	2	14	L.A. Invest. 1 36	Inglewood
Standard Oil Co.	17	2	14	L.A. Invest. 1 37	Inglewood
Standard Oil Co.	17	2	14	L.A. Invest. 1 38	Inglewood
Standard Oil Co.	17	2	14	L.A. Invest. 1 39	Inglewood
Standard Oil Co.	17	2	14	L.A. Invest. 1 40	Inglewood
Standard Oil Co.	17	2	14	L.A. Invest. 1 41	Inglewood
Standard Oil Co.	16	2	14	Stocker 3	Inglewood
Standard Oil Co.	16	2	14	Stocker 4	Inglewood
Standard Oil Co.	7	2	14	Vickers 1 20	Inglewood
Standard Oil Co.	7	2	14	Vickers 2 9	Inglewood
John M. Abrams	13	4	13	1	Long Beach
Abrams & Everett	13	4	13	1	Long Beach
Aiken & Delaney	13	4	13	1	Long Beach
J. W. Alford	13	4	13	1	Long Beach
Apex Petroleum Corp.—					
Cal Mex Oil & Refining Co.	13	4	13	Chandlee 1	Long Beach
Umpire Petroleum Corp.	24	4	13	Locke 36	Long Beach
Associated Oil Co.	13	4	13	Jonte 1	Long Beach
Bailes & Nall	13	4	13	1	Long Beach
Bailes & Nall	18	4	12	2	Long Beach
Barry Oil Assn.	13	4	13	2	Long Beach
Barry Oil Assn.	13	4	13	3	Long Beach
Barry Oil Assn.	13	4	13	4	Long Beach
Beesemyer & Yerkes	13	4	13	B & Y 12	Long Beach
L. Lee Bernstein	19	4	12	1	Long Beach
Bess Oil Co.	13	4	13	1	Long Beach
Bess Oil Co.	13	4	13	2	Long Beach
E. L. Blanton	24	4	13	King 1	Long Beach
M. L. Boles, Special	13	4	13	1	Long Beach
Braly Number Two	13	4	13	Bowles-Griffith 1	Long Beach

OIL FIELD DEVELOPMENT OPERATIONS—Continued.

Company	Sec.	Twp.	Range	Well No.	Field
LOS ANGELES COUNTY—Cont.					
Breslin, Woodward & Sheedy	13	4	13	Breslin, Woodward & Sheedy 1	Long Beach
E. S. Bruce	18	4	12	Bruce 2	Long Beach
Robert Burns	13	4	13		Long Beach
Bush-Voorhis Oil Co.	13	4	13	15	Long Beach
California Petroleum Corp.	13	4	13	Bryant 1	Long Beach
California Petroleum Corp.	13	4	13	Bucklin 1	Long Beach
California Petroleum Corp.	13	4	13	Campbell-Morris 1	Long Beach
California Petroleum Corp.	19	4	12	Fields 18	Long Beach
California Petroleum Corp.	13	4	13	Green 1	Long Beach
California Petroleum Corp.	13	4	13	Hilton 1	Long Beach
California Petroleum Corp.	13	4	13	Los Cerritos Syn. 1	Long Beach
California Petroleum Corp.	13	4	13	Marquis 1	Long Beach
California Petroleum Corp.	13	4	13	Wedum-Aldahl 1	Long Beach
J. L. Clark	13	4	13		Long Beach
E. E. Combs Business Trust No. 3	13	4	13	E. E. Combs 4	Long Beach
E. E. Combs Business Trust No. 3	13	4	13	E. E. Combs 5	Long Beach
J. M. Cooper	13	4	13		Long Beach
Paul L. Cooper	13	4	13	Cooper 1	Long Beach
Cooper, Schenck & Wallace	13	4	13	2	Long Beach
Cooper, Schenck & Wallace	13	4	13	3	Long Beach
Courtney Petroleum Co.	13	4	13	C-16	Long Beach
E. L. Cragen	13	4	13		Long Beach
E. L. Cragen	13	4	13		Long Beach
Craig, Burns & Co., Inc.	13	4	13	2	Long Beach
Craig, Burns & Co., Inc.	13	4	13	7	Long Beach
Craig, Burns & Co., Inc.	13	4	13	8	Long Beach
Craig, Burns & Co., Inc.	13	4	13	Delaney 13	Long Beach
Craig, Burns & Co., Inc.	13	4	13	Delaney 15	Long Beach
Craig, Burns & Co., Inc.	13	4	13	Delaney 22	Long Beach
Craigen & Gray	13	4	13		Long Beach
Joseph B. Dabney	18	4	12	O'Donnell 50	Long Beach
Joseph B. Dabney	13	4	13	Travers 1	Long Beach
Davis & MacMillan Co.	13	4	13	10	Long Beach
K. S. Deeds	29	4	12	Burke 3	Long Beach
A. J. Delaney	13	4	13	5	Long Beach
A. J. Delaney	13	4	13	6	Long Beach
A. J. Delaney	13	4	13	8	Long Beach
A. J. Delaney	13	4	13	9	Long Beach
A. J. Delaney	13	4	13	Delaney 12	Long Beach
A. J. Delaney	13	4	13	Delaney 19	Long Beach
L. T. Edwards	13	4	13	Calahan 1	Long Beach
Featherstone & Preston	13	4	13	Featherstone 14	Long Beach
Featherstone & Preston	13	4	13	Featherstone 15	Long Beach
Fred F. Fitch	13	4	13	Blinn 1	Long Beach
M. A. Fox	13	4	13	Fox-O'Neil 1	Long Beach
Frankley & Andrews	19	4	12	5	Long Beach
Frankley, Andrews & Zellers	13	4	13	1	Long Beach
Frankley, Andrews & Zellers	13	4	13	2	Long Beach
W. F. Gallagher Trust	13	4	13	1	Long Beach
Gem Oil Co.	13	4	13		Long Beach
B. E. Gerner	13	4	13	Bud Gerner 3	Long Beach
George F. Getty, Inc.	13	4	13	L. B. 11	Long Beach
George F. Getty, Inc.	13	4	13	L. B. 12	Long Beach
George F. Getty, Inc.	13	4	13	L. B. 13	Long Beach
Gillespie & Broadway	13	4	13	1	Long Beach
J. P. Harper	13	4	13	1	Long Beach
Havenstrite & Baker	13	4	13	II & B 4	Long Beach
Henderson Petroleum Corp.	13	4	13	24	Long Beach
Henderson Petroleum Corp.	13	4	13	25	Long Beach
Henderson Petroleum Corp.	13	4	13	23	Long Beach
Herwick Interests	13	4	13	Herwick 25	Long Beach
Herwick Interests	13	4	13	Herwick 26	Long Beach
R. E. Ibbetson	13	4	13	7	Long Beach
George W. Johnson	13	4	13	3	Long Beach

OIL FIELD DEVELOPMENT OPERATIONS—Continued.

Company	Sec.	Twp.	Range	Well No.	Field
LOS ANGELES COUNTY—Cont.					
George W. Johnson.....	13	4	13	4	Long Beach
George W. Johnson.....	13	4	13	5	Long Beach
Sam Johnson.....	13	4	13	Sam Johnson 1	Long Beach
Julian Petroleum Corp.....	13	4	13	Anisel 1	Long Beach
Julian Petroleum Corp.....	13	4	13	C. M. & M. 3	Long Beach
Julian Petroleum Corp.....	18	4	12	Patton &	
				Aydell 1	Long Beach
Keck & McWherter.....	13	4	13	1	Long Beach
Keck & McWherter.....	13	4	13	2	Long Beach
Keck & McWherter.....	13	4	13	3	Long Beach
Keck & McWherter.....	13	4	13	4	Long Beach
Kenney & Macerate.....	24	4	13	3	Long Beach
Kenney & Macerate.....	13	4	13	Kenney-	
				Macerate 2	Long Beach
A. H. & R. M. Kiesau.....	13	4	13	1	Long Beach
Kohlbusch & Johnston.....	13	4	13	2	Long Beach
Kupfer-Williams Co.....	19	4	12	1	Long Beach
Lacy, McLachlen & Lacy.....	13	4	13	McLachlen 1	Long Beach
W. I. Lake.....	13	4	13	1	Long Beach
Lewis-Glass Oil Co.....	13	4	13	1	Long Beach
Lindauer Oil Co.....	13	4	13	2	Long Beach
Lindauer Oil Co.....	13	4	13	3	Long Beach
Lindauer Oil Co.....	13	4	13	4	Long Beach
Harry E. MacAdam.....	13	4	13	1	Long Beach
Marine Corp.....	13	4	13	54	Long Beach
The McKeon Oil Co.....	13	4	13	3	Long Beach
The McKeon Oil Co.....	13	4	13	4	Long Beach
The McKeon Oil Co.....	13	4	13	5	Long Beach
The McKeon Oil Co.....	13	4	13	6	Long Beach
The McKeon Oil Co.....	13	4	13	7	Long Beach
The McKeon Oil Co.....	13	4	13	8	Long Beach
The McKeon Oil Co.....	13	4	13	9	Long Beach
The McKeon Oil Co.....	13	4	13	McKeon-	
				Cerritos 1	Long Beach
John McNeice and J. W. Nard.....	13	4	13	Norwood 1	Long Beach
E. J. Miley.....	13	4	13	Los Cerritos 1	Long Beach
E. J. Miley.....	13	4	13	Los Cerritos 2	Long Beach
Miller & McKinnis.....	13	4	13	Marine Trust	
				& Savings	
				Bank 1	Long Beach
Miller & McKinnis.....	13	4	13	Marine Trust	
				& Savings	
				Bank 2	Long Beach
J. E. O'Donnell.....	19	4	12	Berry 1	Long Beach
J. E. O'Donnell.....	18	4	12	O'Donnell 49	Long Beach
J. E. O'Donnell.....	13	4	13	O'Donnell 51	Long Beach
J. E. O'Donnell.....	18	4	12	O'Donnell 52	Long Beach
J. E. O'Donnell.....	19	4	12	O'Donnell 54	Long Beach
Ozark Oil Co.....	13	4	13	1	Long Beach
Ozark Oil Co.....	13	4	13	2	Long Beach
Ozark Oil Co.....	13	4	13	3	Long Beach
Ozark Oil Co.....	13	4	13	4	Long Beach
Painted Hills Oil Assn.....	13	4	13	9	Long Beach
W. A. Playter.....	13	4	13	Bunny 1	Long Beach
Rainbow Petroleum Co.....	18	4	12	4	Long Beach
Rainbow Petroleum Co.....	19	4	12	5	Long Beach
Rainbow Petroleum Co.....	18	4	12	6	Long Beach
Rainbow Petroleum Co.....	13	4	13	7	Long Beach
Rainbow Petroleum Co.....	13	4	13	8	Long Beach
Repetto Hills Petroleum Corp.....	13	4	13	3	Long Beach
Repetto Hills Petroleum Corp.....	13	4	13	4	Long Beach
Retsof Drilling Co.....	13	4	13	76	Long Beach
Retsof Drilling Co.....	13	4	13	77	Long Beach
Retsof Drilling Co.....	13	4	13	78	Long Beach
Retsof Drilling Co.....	13	4	13	79	Long Beach
Retsof Drilling Co.....	13	4	13	80	Long Beach
Retsof Drilling Co.....	13	4	13	82	Long Beach
Retsof Drilling Co.....	13	4	13	83	Long Beach

OIL FIELD DEVELOPMENT OPERATIONS—Continued.

Company	Sec.	Twp.	Range	Well No.	Field
LOS ANGELES COUNTY—Cont.					
J. A. Rhea.....	13	4	13	1	Long Beach
Ring Petroleum Corp.....	13	4	13	5	Long Beach
J. T. Robertson Co.....	13	4	13	3	Long Beach
J. T. Robertson Co.....	13	4	13	4	Long Beach
Royal Oil Co.....	13	4	13	1	Long Beach
Star Petroleum Co.....	13	4	13	Colby 1	Long Beach
Walter P. Temple Oil Co.....	13	4	13	1	Long Beach
W. O. Todd.....	13	4	13	1	Long Beach
Transport Oil Co.....	13	4	13	15	Long Beach
Tryon & Brain.....	13	4	13	Lineberger 1	Long Beach
The United Oil Co.....	13	4	13	3	Long Beach
The United Oil Co.....	13	4	13	Cook 1	Long Beach
The United Oil Co.....	19	4	12	Hass 1	Long Beach
The United Oil Co.....	13	4	13	Lineberger 2	Long Beach
The United Oil Co.....	13	4	13	Lineberger 3	Long Beach
The United Oil Co.....	13	4	13	Stakemiller 1	Long Beach
The United Oil Co.....	13	4	13	Taylor 1	Long Beach
The United Oil Co.....	13	4	13	Taylor 2	Long Beach
W. M. C. Syndicate.....	13	4	13	1	Long Beach
Weaver Bros. Drilling Co.....	24	4	13	2	Long Beach
Wheeler & O'Brien.....	13	4	13	Starr 1	Long Beach
H. L. Whiston.....	18	4	12	2	Long Beach
H. L. Whiston.....	18	4	12	3	Long Beach
Wilshire Oil Co., Inc.....	13	4	13	Wilshire A-1	Long Beach
L. V. Wilson.....	13	4	13	1	Long Beach
McGinley Oil Co.....	6	23	11	24	Montebello
St. Helens-Riverside Properties.....	2	2	12	Monterey 11	Montebello
Standard Oil Co.....	6	2	11	Baldwin 65	Montebello
Standard Oil Co.....	6	2	11	Temple 16	Montebello
Superior Oil Co.....	2	2	12	Manz 1	Montebello
Barnsdall Oil Co.....	18	3	13	O'Dea 8	Rosecrans
Barnsdall Oil Co.....	18	3	13	O'Dea 9	Rosecrans
Walter H. Fisher Corp.....	7	3	13	15	Rosecrans
Union Oil Co.....	18	3	13	Howard Park 13	Rosecrans
Union Oil Co.....	17	3	13	Padelford 3	Rosecrans
Union Oil Co.....	19	3	13	Rosecrans 7	Rosecrans
California Petroleum Corp.....	5	3	11	Wickham 2-A	Santa Fe Springs
General Petroleum Corp.....	5	3	11	Santa Fe 18-A	Santa Fe Springs
California Petroleum Corp.....	8	4	14	Waldron 2	Torrance
C. C. M. O. Co.....	9	4	14	Del Amo 29	Torrance
C. C. M. O. Co.....	9	4	14	Del Amo 40	Torrance
C. C. M. O. Co.....	9	4	14	Del Amo 46	Torrance
C. C. M. O. Co.....	8	4	14	Del Amo 80	Torrance
C. C. M. O. Co.....	8	4	14	Del Amo 86	Torrance
C. C. M. O. Co.....	8	4	14	Del Amo 92	Torrance
Wm. E. Garner.....	18	4	13	2	Torrance
General Petroleum Corp.....	8	4	14	Carson 6	Torrance
George F. Getty, Inc.....	8	4	14	Torrance 28	Torrance
Shell Co.....	9	4	14	Redondo	
				Comm. 7	Torrance
Shell Co.....	9	4	14	Redondo	
				Comm. 8	Torrance
Shell Co.....	9	4	14	Redondo	
				Comm. 13	Torrance
Standard Oil Co.....	22	4	14	Marble Lease 26	Torrance
California Petroleum Corp.....	17	2	11	Seward-	
				Rideout 4	Whittier
Burlingham Petroleum Corp.....	11	4	12	Dubin 1	
D. & B. Oil Co.....	3	2	10	1	
Jeffrey, Overton & Halfhill.....	13	11	14	Jeffrey 1	
Marland Oil Co.....	26	2	14	Connolly 1	
Marland Oil Co.....	32	5	17	Wickham 1	
Milham Exploration Co.....	11	4	16	Conroy 2	
Milham Exploration Co.....	34	2	15	Playa del Rey 2	
Pan American Petroleum Co.....	2	3	15	Pacific	
				Southwest 2	
George R. Rider.....	12	3	15	1	
Rudd-Asmussen.....	9	6	12	1	

OIL FIELD DEVELOPMENT OPERATIONS—Continued.

Company	Sec.	Twp.	Range	Well No.	Field
MERCED COUNTY:					
Henry L. Kuns.....	5	12	9	2	-----
MONTEREY COUNTY:					
Associated Oil Co.....	2	20	6	1	-----
Harriman Jones Oil Co.....	21	19	6	2	-----
NAPA COUNTY:					
H. Rambke.....	29	8	3	1	-----
ORANGE COUNTY:					
Shell Co.....	2	3	10	Orange 10	Brea Olinda
Union Oil Co.....	1	3	10	Stearns 66	Brea Olinda
Union Oil Co.....	1	3	10	Stearns 67	Brea Olinda
E. L. Blanton.....	17	3	9	Gaulden 1	Coyote Hills
Chiksan Oil Co.....	18	3	9		Coyote Hills
Union Oil Co.....	22	3	11	McNally 1	Coyote Hills
Julian Petroleum Corp.....	7	6	10	Farnsworth 1	Huntington Beach
Standard Oil Co.....	29	5	11	Bolsa 23	Huntington Beach
Standard Oil Co.....	34	5	11	Bolsa 24	Huntington Beach
Standard Oil Co.....	34	5	11	Huntington A 30	Huntington Beach
Standard Oil Co.....	4	6	11	Huntington B 40	Huntington Beach
Standard Oil Co.....	3	6	11	Huntington B 41	Huntington Beach
Standard Oil Co.....	34	5	11	Huntington B 42	Huntington Beach
Standard Oil Co.....	4	6	11	Huntington B 43	Huntington Beach
Standard Oil Co.....	3	6	11	Huntington B 44	Huntington Beach
Standard Oil Co.....	12	6	11	Newland 1	Huntington Beach
Julian Petroleum Corp.....	21	6	10	Mesa 4	Newport
Julian Petroleum Corp.....	21	6	10	Strowbridge A-1	Newport
Julian Petroleum Corp.....	21	6	10	Mesa 5	Newport
Julian Petroleum Corp.....	21	6	10	Strowbridge B-1	Newport
J. J. Rekar.....	21	6	10		2 Newport
J. J. Rekar.....	21	6	10		3 Newport
Sunland Oil Assn.....	21	6	10		2 Newport
California Petroleum Corp.....	33	3	9	Richfield	
				Cons. 11	Richfield
California Petroleum Corp.....	28	3	9	Yarnell 18	Richfield
General Petroleum Corp.....	28	3	9	Thompson 7	Richfield
S. H. Keoughan, Trustee.....	29	3	9	Kraemer-	
				Keoughan 1	Richfield
Union Oil Co.....	33	3	9	Yorba Linda	
				Group 9	Richfield
Standard Oil Co.....	26	5	10	Plavan 1	-----
SAN BENITO COUNTY:					
Reorganized Homestake Divide Mining Co.....	14	17	11		2
SAN DIEGO COUNTY:					
George O. MacGregor.....	19	16	3		1
SAN LUIS OBISPO COUNTY:					
Carissa Oil Co.....	26	32	22		1
Kerntaft Petroleum Co.....	35	12	25		1
Fred C. Macomber.....	33	12	25		1
Portland Petroleum Corp.....	31	27	15	Whitley 1	-----
E. K. Potter.....	15	32	22		1
SANTA BARBARA COUNTY:					
Smith & Barmore.....	--	4	26	1	Summerland
J. R. Steele.....	24	6	32	1	-----
SANTA CLARA COUNTY:					
Alfred Tinally.....	7	8	1	1	-----
SONOMA COUNTY:					
Tom Burger.....	--	5	6	1	-----

OIL FIELD DEVELOPMENT OPERATIONS—Continued.

Company	Sec.	Twp.	Range	Well No.	Field
VENTURA COUNTY:					
Calumet Oil Co.-----	3	3	19	15	Bardsdale
J. A. Hess -----	33	2	20	8	Conejo
Surprise Oil Syn.-----	33	2	20	9	Conejo
Surprise Oil Syn.-----	33	2	20	10	Conejo
Surprise Oil Syn.-----	33	2	20	11	Conejo
Surprise Oil Syn.-----	33	2	20	12	Conejo
Ruth J. Bishop-----	34	5	19	1	Sespe
White Star Oil Co.-----	33	5	19	20	Sespe
Oak Ridge Oil Co.-----	18	3	20	Willard 19	So. Mountain
Associated Oil Co.-----	22	3	23	Hartman 3	Ventura
Associated Oil Co.-----	27	3	23	Lloyd 27	Ventura
Bolsa Chica Oil Co.-----	22	3	23	Hartman 1	Ventura
General Petroleum Corp.-----	28	3	23	Notten 10	Ventura
Milham Exploration Co.-----	19	3	22	Sexton 1	Ventura
Petroleum Securities Co.-----	28	3	23	Willett 1	Ventura
Shell Co.-----	28	3	23	Edison 6	Ventura
Shell Co.-----	27	3	23	Gosnell 18	Ventura
Shell Co.-----	28	3	23	Gosnell 19	Ventura
Shell Co.-----	28	3	23	Gosnell 20	Ventura



SPECIAL ARTICLES.

Detailed technical reports on special subjects, the result of research work or extended field investigations, will continue to be issued as separate bulletins by the Bureau, as has been the custom in the past.

Shorter and less elaborate technical papers and articles by members of the staff and others are published in each number of 'Mining in California.'

These special articles cover a wide range of subjects both of historical and current interest; descriptions of new processes, or metallurgical and industrial plants, new mineral occurrences, and interesting geological formations, as well as articles intended to supply practical and timely information on the problems of the prospector and miner, such as the text of new laws and official regulations and notices affecting the mineral industry.

THE SO-CALLED "MYSTERIOUS WHITE METAL."

FRANK SANBORN, Mineral Technologist.

For at least 30 years past, reports of a 'mysterious white metal' have come to the State Mining Bureau at irregular intervals, from several localities in California but particularly from the 'lava beds' area of Modoc and Lassen counties. During the latter part of 1921, the subject was given special attention in the laboratory of the State Mining Bureau and by the U. S. Bureau of Mines Rare and Precious Metals Experimental Station at Reno, Nevada.

The correspondence and the conclusions reached at that time were published¹ with the comment that they "should retire the ghost of this 'mysterious metal' at once and for all time." On the contrary, however, like Banquo's ghost it still persists in periodically reappearing. Only recently, the writer has had to demonstrate on several occasions that there is nothing either mysterious or rare or new about the results obtained. For this reason we are republishing herewith the correspondence above referred to, and also a circular just to hand from the U. S. Bureau of Mines (see page 104).

"CALIFORNIA STATE MINING BUREAU

San Francisco, California, February 4, 1922.

"DR. S. C. LIND,

Supt. U. S. Bureau of Mines Experiment Station,
Reno, Nevada.

re 'white metal' investigation:

DEAR SIR: "As stated in our letter of April 11, 1921, this subject has come to the attention of the laboratory of the State Mining Bureau at various times during the past twenty years or more. Until recently the samples submitted came entirely from the northern end of the state, particularly Lassen and Modoc counties, and they have invariably been basic igneous rocks, mainly basalt.

"In no case have we been able to reduce or produce any 'white metal' from the materials submitted. Of a number of samples investigated and analyzed, it was noted that the material usually contained rock-forming minerals which rendered the rock rather easily fusible, also the element titanium was present. From the behavior under these tests, our present chemist, Mr. Frank Sanborn, suggests that in fusing the rocks in question it is possible that a piece of iron coming in contact with the molten mass would have a crude iron-alloy formed on the surface—possibly

¹ Report XVIII of State Mineralogist, pp. 86-88, Feb. 1922.

ferro-silicon or a complex ferro-alloy. His conclusion is that the so-called 'white metal' is probably such an alloy.

He also learned that a friend of his, Mr. C. F. Sherwood, 503 Market street, San Francisco, spent considerable time and money in 1920-21, investigating this 'mysterious metal,' or 'white metal' in hopes that he could form a hard steel with acid-resisting properties suitable for mine pumps, cyanide filters, etc. The rock came from Modoc County, California. The following is a copy of a complete analysis made on this material by Walter L. Gibson, Oakland, Cal.:

"WALTER L. GIBSON,

successor to

Assay Office, Chemical Laboratory,

824 Washington Street,

Oakland, Cal., September 16, 1920.

"The Oliver Sherwood Company,
503 Market street,
San Francisco, California.

"GENTLEMEN: A sack of rock deposited by you at this laboratory for analysis, further known as Lab. 69482, gave the following results:

Silica -----	44.50%	
Sulphur -----	0.27	} Combined as Fe_2S_3
Iron -----	0.23	
Iron oxide (Fe_2O_3) -----	9.89	
Iron oxide (FeO) -----	7.55	
Alumina -----	10.51	
Lime -----	10.00	
Magnesia -----	3.82	
Titanium oxide (TiO_2) -----	2.00	
Phosphoric acid -----	0.90	
Water @ 100 C. -----	2.30	
Water above 100 C. -----	2.00	
Potassium oxide (K_2O) -----	0.57	
Sodium oxide (Na_2O) -----	5.10	
Carbonic acid gas (CO_2) -----	Trace	
Nickel -----	Trace	
Total -----	99.64%	

(Signed) WALTER L. GIBSON."

"Mr. Sherwood informed our Mr. Sanborn that his investigations did not yield any results of practical value.

"On several occasions during the past eighteen months when such rocks have come to the State Mining Bureau for identification, we have written the parties, asking for a sample of the metal said to have been reduced; but we have not yet received any in reply. Recently, however, a sample was brought in by a party who had become 'interested in the mysterious metal.' He had a generous sample of the rock and some of the metal claimed to have been reduced from it. This metal resembled the skimmings from a mass of molten solder, and proved to consist mainly of lead with impurities (apparently tin, copper, etc.). This metal could not have come from the rock that was submitted for identification.

"Dr. A. S. Eakle, professor of mineralogy, University of California, states that in the summer of 1915 while in Mono County, California, near Topaz, an occurrence of such a 'white metal' ore was reported to him and that he gathered some samples of the rock which proved to be quartzite containing pyrite. His informant repeated his experiments in Dr. Eakle's presence; and although not as successful in obtaining an actual reduction of metal as in his reported tests, Dr. Eakle says that the following had probably occurred: As the material was heated in a black-smith's forge, there was plenty of carbon (coal or coke) present to reduce some iron from the pyrite. The iron may have alloyed with some silica to form ferro-silicon, or with some carbon to form steel. The hole made in the shovel in the reported tests may have been made by the sulphur attacking the shovel rendering

it brittle at the point of attack or the forge blast may have burned a hole through if the shovel was worn thin.

"Under separate cover we are mailing you samples of rocks from two localities received at this office as yielding the 'white metal.' Needless to say, we found none such in either sample. As our laboratory is equipped for qualitative work only, we are limited in our scope when it comes to research work.

"We will appreciate copies of your report when you have completed these investigations.

Very truly yours,

(Signed) FLETCHER HAMILTON,
State Mineralogist."

"DEPARTMENT OF THE INTERIOR

Bureau of Mines

Rare and Precious Metals Experiment Station,

Reno, Nevada.

February 10, 1922.

"MR. FLETCHER HAMILTON,
State Mineralogist,
San Francisco, California.

"DEAR SIR: I am very much indebted for your letter of February 4th on this subject. The question of 'white metal' has also been brought to our attention repeatedly during the past several years.

"At one time in Colorado we examined very carefully a specimen of rock supposed to contain 'white metal' and were unable to detect anything which should give the properties alleged to iron. Since coming to Nevada, we have reviewed the whole subject very carefully with the Mackay School of Mines, and consulted other authorities. The consensus of opinion seemed to be that there was nothing in the claims whatsoever, and we decided that the problem was not worthy of further investigation and made no publication on the subject.

"If unusual properties are imparted to iron in forging it in the presence of such rock we believe that they are due to the heat treatment and also that a surface alloy may be formed, as suggested by Dr. A. S. Eakle, quoted in your letter.

"We do not propose to make any investigation of the present sample from Modoc County, as we had long ago decided the subject does not merit further work, and we are very pleased to be confirmed in this view by your opinion."

Very truly yours,

(Signed) S. C. LIND,
Superintendent.

THE LEGENDARY "WHITE METAL" AND ITS "ORE."*

By C. W. DAVIS.¹

"As a by-product of its investigational work, the Rare and Precious Metals experiment Station, at Reno, Nev., of the Bureau of Mines, is from time to time requested to identify worthless rocks that are usually submitted in good faith by prospectors, miners, and others who think the rock may contain elements of value. Usually a cursory inspection or a few simple tests is all that is necessary to reveal the nature of the barren material, and the finder usually accepts the bureau's statement that the material is worthless. Sometimes it is not so easy to convince the hopeful searcher, and he may even visit the Station in person and ask to be permitted to view a test, or even to demonstrate the qualities of the 'rare' mineral that he has found. One of the most difficult fellows to convince is the seeker of 'white metal.'

"There is a legend that Mexicans and other old settlers in the Southwest knew of an 'ore' which was packed around pieces of iron or steel that they wished to harden. The metal was heated in a wood fire in contact with the 'ore' and then quenched in water. Axles of springless wagons so treated were said to have been made 'glass

* Circular No. 6000, U. S. Bureau of Mines, Dec. 1925.

¹ Associate Chemist; Rare and Precious Metals Experiment Sta. (Reno, Nev.) Bureau of Mines, Dept. of Commerce. In cooperation with Mackay School of Mines, Univ. of Nevada.

hard,' and to wear two or three times as long as ordinary axles and tires so treated were described as 'ringing like a bell' when suspended and struck with a hammer. This action was said to be due to a 'white metal' that was extracted from the 'ore' and alloyed with the iron by the treatment.

"Although this story has never been shown to have had any fact as a basis, it appears from time to time under slightly different guises. As a result, for over 20 years, various laboratories at different times have received many kinds of rocks (designated as 'ores') which have been claimed to give remarkable properties to metals, such as making them 'glass hard,' extremely tough, or resistant to corrosion. Many of these rocks are basic igneous rock, such as altered diabase, olivine, pyroxenite, obsidian, basalt, amphibolite, also pyritic quartzite, aluminum silicate, magnetite, tourmaline, sandstone; in fact almost every known rock is represented. Most of the samples come from California and Nevada, but nearly all western States are included.

"The claimant's method is usually to heat the metal in contact with the rock, supposing that a 'white metal' is produced from the 'ore' which alloys with the metal being treated. The temperatures used have ranged from 200° F. to that of the electric arc. The favorite heating device is the blacksmith's forge. The extraction of the 'white metal' itself (which, it was said, could be used directly in forming an alloy, as for example by putting a little on a knife blade and heating in a bunsen flame¹) was described as having been performed in some cases by simply melting the 'ore,' in others by melting with fluxes, and in others by melting with fluxes and a reducing agent.

"The bureau's laboratory at Reno has in the past few years received various samples of this sort, some of the claimants presenting their samples in person and endeavoring to demonstrate the virtues of their 'process.' As was to be expected, the results indicate that work along this line, and money put into propositions involving the 'mysterious white metal' and its 'ore,' would be wasted.

"The tests by the bureau and other laboratories, following the claimant's procedures have usually shown no hardening effect, although in a few tests some hardening of iron or steel was produced due either to case hardening from heating the metal in contact with carbon, protected from oxidation by a coating of flux, or in some instances to the formation of a crude silicon alloy. Many ordinary fusible rocks, and even fluxes without rock, will give these same results. The claim of 'glass hardness' for treated metal is obviously caused by hard slag sticking to the metal being mistaken for hardened metal. The protection of the treated metal against corrosion was improved.

"A certain basis for confusion lies in the fact that some rocks when mixed with soda (sodium carbonate or bi-carbonate) placed in a crucible, and heated in a blacksmith's forge, give white pellets of very pure iron which are not readily attacked by acids, leading the experimenter to believe that he has one of the platinum metals.

"For example, one claimant alleged that his 'ore' when powdered and sprinkled on Norway iron and heated in a forge, would cause the surface of the metal to be coated with a lustrous, glass hard noncorrodible material, and the iron would change to steel. A treated specimen was submitted to the bureau station at Berkeley, Cal.² An analysis showed the ore to be obsidian. A small bar of Norway iron was packed in the powdered mineral and heated electrically above the fusion point of the mineral *in the absence of carbon*. The submerged part acquired a brilliant silver-like luster, but was not hardened or changed in any other way. The effect was apparently nothing more than a thorough cleansing of the surface, which no doubt would be less corroded than a surface more or less coated with iron oxide. The alleged 'glass hardness' of the submitted specimen was shown to be due to small masses of the fused mineral adhering to rough spots on the surface of the metal.

"In another instance, the 'ore' was basalt; the claimants were positive of the hardening effect, and attempted to demonstrate this by heating quarter-inch square bars of Norway iron to a bright red in a forge, dipping them in the powdered mineral, and repeating the process until the end of the bar was well coated with slag. On quenching in water the coated portion showed a lustrous surface, and on twisting the bar the treated part proved to be somewhat hardened. This, however, was found to be due to case hardening caused by particles of coke which were held in contact with the iron by coating of fused mineral, this coating also

¹ A case investigated at the Mackay School of Mines.

² Investigated by L. M. Duschak.

excluded oxygen. Many other cases similar to these were all easily explained, and lead to the conclusion that the claimants were mistaken as to what could be accomplished by the 'ores.'

"All attempts of investigators to extract 'white metal' from 'ore' following the directions of claimants, have usually failed to yield any metal whatever, except when the treatment called for the fluxing at high temperature with charcoal of a rock that happened to contain considerable iron. In this case a small amount of metallic iron was reduced from the iron mineral of the rock. The specimens of the 'white metal' said to be 'melted' from the 'ore' are invariably impure metals, mostly lead, copper, zinc, and iron, or simply slag. In testing some of these, it was found that the lead had been introduced by fluxing the rock with charcoal in an old assay crucible that had contained a little slag high in lead, the slag being reduced and lead formed. Lead, copper or zinc in some specimens had been introduced as impurities in the fluxes used for treating the 'ore' or by using a container in which they were present, as for example, zinc from galvanized iron.

"One sample of pulverized 'ore' (volcanic rock) was claimed to produce 'white metal,' by melting with flux in an electric arc with carbon electrodes, that would harden steel, iron, and copper. A test¹ of this method, using a carbon ladle as container, showed the 'white metal' to be iron.

"Another claimant stated that 'white metal' could be produced by fusion in a carbon ladle as described above, also by reduction in crucibles using fluxes and carbon. The metal was said to harden copper or brass and to make cast iron malleable. In addition to the ladle test² the rock was reduced in clay crucibles by fluxing with soda and borax, with and without the addition of carbon. Without carbon no metal was produced. With carbon a small amount of metallic iron, contained in the original ore, was produced.

"In several other instances, the only metal produced from the 'ore' proved to be iron reduced from the rock by heating with carbon. Many samples of metal claimed to have been produced from 'ore' were lead which had been introduced during 'extraction' of the metal either through impure fluxes, or by reducing lead from the slag retained in old assay crucibles that had been used by the claimants in making the tests.

"A metal, said to be extracted from what proved to be a basic igneous rock, was found to be impure lead with a little tin and copper, and resembled skimmings from molten solder.³ Another metal was found to be impure lead,⁴ which the client admitted may have come from the forge where babbitt had been spilled. Still another was practically pure lead reduced from the fluxes used.⁵

"White metal said to be produced from a rock that was limestone was found to be zinc, which probably came from a galvanized can that the claimant had used. Various rocks claimed to have 'white metal' virtues, said to be due to platinum, vanadium, uranium, or some other rare metal, did not contain these metals, or only slight traces, but were simply good fluxes and cleaned iron just as any good flux will, and had no power in themselves to alter the properties of the iron. Any hardening action was probably due to case hardening of the iron by the coal, coke, wood, or other fuel used, or by carbonaceous matter in the rock. In one instance it was found that when the pulverized 'ore' (basalt) was heated as requested, in contact with iron in an electric arc, the iron became hard, because it had been partly converted to a crude alloy of iron and silicon. Also, a piece of iron on repeated dipping in a powdered 'ore' as directed, quenching, and cooling, had a hard lustrous surface. This was undoubtedly due to case hardening from heating in contact with the coke in the forge, protected from oxidation by a coating of slag. Small pieces of slag attached to the metal submitted by the claimant scratched glass. The same results were obtained by a flux.

"A case in which the claimant found a coating of 'white metal' on the outside of an iron ladle used to flux his 'ore' was investigated. The 'white metal' was found to be slag.⁶ Other cases where the 'white metal' was said to have 'eaten' its way through an iron shovel and plated out on the edges of the hole were studied.⁷ The hole was caused by sulphides in the 'ore' which reacted with the iron of the

¹ Investigator, C. C. Anthony, San Francisco, Cal.

² Investigator, F. S. Mulock, chemical engineer, San Francisco.

³ Analyst, Fletcher Hamilton, State Mineralogist, San Francisco, Cal.

⁴ Analyst, A. A. Hanks, chemist, assayer and metallurgist, San Francisco, Cal.

⁵ W. L. Piers, assayer and chemist, Denver, Colo.

⁶ Investigator, H. W. Young, metallurgist, Palo Alto, Cal.

⁷ A. S. Eakle, mineralogist, Berkeley Cal.

shovel and made it brittle, and by 'burning' with the forge blast. The 'plating' was the result of the cleansing action of the flux which left the iron bright and silver-like.

"In sum, it may be said that all authentic tests have given results that may be thoroughly explained by the usual properties of the materials used. One is forced to conclude, therefore, that the various unsubstantial claims that have been made were due to careless tests, to erroneous conclusions from these tests or to an attempt to defraud.

"Acknowledgments.

"It is a pleasure to acknowledge the cooperation of those who so kindly informed the writer of the results of their investigations so that they might be included in this circular. Harry E. Tuft, of the Bureau of Mines, assisted in preparing the manuscript.—Information Circular, Bureau of Mines, Department of Commerce."



ADMINISTRATIVE DIVISION.

WALTER W. BRADLEY, Deputy State Mineralogist.

Hydraulic Mining Commission.

By an act of the legislature (Chap. 207, Stat. 1925, introduced by Assemblyman H. C. Cloudman of Berkeley) a commission was created consisting of the State Mineralogist and the Surveyor General to investigate the possibilities and the feasibility of resuming hydraulic mining of gold-bearing placer gravels. A report of their findings is to be made to the legislature at its forthcoming session in 1927.

Personnel.

Mr. Arthur Jarman, mining engineer, has been engaged as 'secretary' and engineer for the Hydraulic Mining Commission to carry on the field surveys in connection with this investigation.

Obituary.

William Irelan, Jr., State Mineralogist of California from June 1, 1886, to May 1893, passed away at his home in Berkeley, on November 9, 1925, at the age of 85 years. The original State Mining Bureau Act was approved April 16, 1880, and a supplemental act was passed in March, 1885, providing for the appointment of a Board of Trustees to have direction and control of the Bureau. Mr. Irelan was appointed by the Governor as a member of the first board assembled under that act, and the following year was appointed State Mineralogist on the resignation of Mr. Henry G. Hanks, the first to occupy that office under the original act of 1880. Mr. Irelan was born in Delaware, and was educated in England and Germany, in which latter country he was married in 1869. He is survived by his wife, Mrs. Linna V. Irelan, and a sister, Mrs. S. T. Sniffin.

During Mr. Irelan's incumbency as State Mineralogist, the following reports were published: Report VI, Part 2; VII, VIII, IX, X, XI, Bulletin No. 1.

New Publications.

During the quarterly period covered by this issue, the following Bureau publications have been made available for distribution:

- Bulletin No. 79. 'Magnesite in California,' by Walter W. Bradley. Cloth bound; 147 pages, and illustrated with 62 half-tone plates and 11 line-cut drawings (including maps). Price \$1 postpaid.
- Bulletin No. 96. 'California Mineral Production for 1924,' by Walter W. Bradley. Paper, 174 pages, and illustrated with 11 half-tone plates and 1 line map. Distributed without charge.
- Mining in California (quarterly), October, 1925, being Chapter 4 (completing volume) of State Mineralogist's Report XXI, and containing the Index for the year. Price 25 cents.
- Summary of Operations, California Oil Fields: Vol. 11, Nos. 1, 2, 3, and 4, July, August, September, and October, 1925, respectively.
- Commercial Mineral Notes: Nos. 32, 33, 34, November-January (inc.). These 'notes' carry the lists of 'mineral deposits wanted' and 'minerals for sale,' issued in the form of a mimeographed sheet, monthly. It is mailed free of charge to those on the mailing list for 'Mining in California.'

Mails and Files.

The Bureau maintains in addition to its correspondence file and the library, a mine report file which includes reports on some 7500 mines and mineral properties in California.

During the period covered by this quarterly report, there were 3750 letters received and answered at the San Francisco office alone, covering almost every phase of prospecting, mining and developing mineral deposits, reduction problems, and marketing of refined products.

DIVISION OF MINERALS AND STATISTICS.

Statistics, Museum, Laboratory.

WALTER W. BRADLEY, Deputy State Mineralogist.

Estimate of 1925 Output.

CALIFORNIA'S MINERAL PRODUCTION IN 1925 AGAIN BREAKS RECORD.

The total value of the mineral production of California for the year 1925, just closed, is conservatively estimated to have been approximately \$422,974,500. This is, in part, detailed in the tabulation below; but, as there are sixty mineral substances on California's commercial list, it is impractical at this early date to obtain anything approaching definite figures on other than the more important items. The blank report forms are being mailed out to the operators in all mineral lines, and the date of publication of the final and complete report will depend upon the promptness of their replies.

The estimated total of \$422,974,500 is an increase of more than \$48,000,000 over the 1924 production which in turn surpassed the previous record value of the year 1923. This increase is due mainly to petroleum, and in part also to cement. Reports at hand indicate an increase of at least 2,000,000 barrels of crude oil in 1925 over the 1924 yield, making a total of 231,000,000 barrels (in round numbers). Assigning an average value at this early date before reports are in hand giving results of the actual sales figures is not an easy task because of the wide variations in grades, and the price changes which have been posted during the year. Approximately 85 per cent of the crude oil produced in California in 1925 was above 20° Baumé, some of it ranging as high as 50° B.; while the low-grade oil ranged down to 9° B. Prices were raised on February 4, 1925, from \$1 to \$1.25 per bbl. for the lower grades, and from \$1.85 to \$2.40 per bbl. for the highest grades, with the intermediate grades in proportion. These prices governed until September 22d, when a reduction was posted on a graduated scale according to fields; then another drop October 27th, giving a price range of 75¢ to \$2.30 per barrel, the decreases for the most part being on the low-gravity fuel grades. This has resulted in a curtailment of production from the low-gravity wells, so that on December 1st there was a "shut-in capacity" of approximately 61,000 barrels per day total. Weighting the above facts, with the quantities by grades and prices, we have taken an average value of \$1.39 per barrel as at least a conservative estimate for the 1925 yield of petroleum in California.

Receipts of bullion at the mint and smelters show only a slight decrease in the gold yield for 1925. That the decrease was not greater as a result of a smaller yield from some of the larger quartz mines and from copper ores, is due to an increased recovery by the gold dredges. There was a decreased output of silver from the Rand district and from copper ores, which was in part offset by increased shipments of lead ores yielding a total of approximately 7,000,000 pounds of lead (being 2,000,000 pounds more than 1924). Copper shows a drop of around 6,000,000 pounds in amount; with zinc increasing nearly three-fold. Lead and zinc prices maintained high levels during the year, averaging 8.99¢ and 7.54¢ per pound, respec-

tively. Copper averaged 14.1¢ per pound and silver 69.07¢ per fine ounce. Quicksilver prices advanced materially during 1925, but this did not result in increased yield.

As the demand for building materials continued active during 1925, nearly all items of the structural group will show increased quantities and total values, especially cement, brick, hollow building tile, crushed rock, sand and gravel. Magnesite shipments decreased slightly, though the prices remained practically on a level with 1924. There were no notable changes reported in the general status of the miscellaneous 'industrial' group, nor among the salines.

The estimated quantities and values for 1925 are tabulated as follows:

\$13,000,000	gold.
2,141,000	(3,100,000 fine oz.) silver.
6,486,000	(46,000,000 lb.) copper.
629,300	(7,000,000 lb.) lead.
652,200	(8,650,000 lb.) zinc.
30,000	iron and manganese ores.
619,000	(7,750 flasks) quicksilver.
30,000	(250 fine oz.) platinum.
320,000,000	(231,000,000 bbl.) petroleum.
15,000,000	(210,000,000 M. cu. ft.) natural gas.
25,000,000	(12,500,000 bbl.) cement.
16,500,000	crushed rock, sand and gravel.
10,000,000	brick and hollow building tile.
887,000	(65,700 tons) magnesite.
2,000,000	other structural materials, including granite, et al.
5,500,000	miscellaneous 'industrial' minerals.
4,500,000	salines (including borates, potash, salt, et al).

\$422,974,500 total value.

MUSEUM.

The Museum of the State Mining Bureau possesses an exceptionally fine collection of rocks and minerals of both economic and academic value. It ranks among the first five of such collections in North America; and contains not only specimens of most of the known minerals found in California, but much valuable and interesting material from other states and foreign countries as well.

Mineral specimens suitable for exhibit purposes are solicited, and their donation will be appreciated by the State Mining Bureau as well as by those who utilize the facilities of the collection.

The exhibit is daily visited by engineers, students, business men, and prospectors as well as tourists and mere sightseers. Besides its practical use in the economic development of California's mineral resources, the collection is a most valuable educational asset to the state and to San Francisco.

LABORATORY.

FRANK SANBORN, Mineral Technologist.

The production of clays and other aluminum silicates is increasing each year in California, and in all probability many new deposits of clay and possibly deposits of andalusite and cyanite will be discovered as the state becomes more thoroughly prospected.

During 1924, 417,828 tons of pottery clay and 5290 tons of clays of the montmorillonite group were produced, the latter being utilized as a substitute for fuller's earth.

The clays of the montmorillonite group, although not suitable for pottery products, are being used in the preparation of some soaps; and when these clays have the properties of clarifying oils to the satisfaction of the refiners they are used as fuller's earth. When the peculiar properties of the montmorillonite clays are more fully known, more uses may be found for them. The fact that most of the montmorillonite clays are attacked by hot sulphuric acid, the alumina going into solution, is interesting and may lead to the discovery of new and important uses for these aluminum silicates. The alumina can be precipitated as an oxide from the sulphuric acid solution by adding a solution of tannic acid.

Many samples of clays and kaolinized rocks are received at the laboratory of the State Mining Bureau, but usually it is not possible to give the sender an entirely satisfactory report for the reason that the producers of clay products and the oil refiners decide mainly by practical tests whether a clay is satisfactory for their particular purpose. The Livermore Fire-brick Company is interested in all clays that have a very high fusing point regardless of plasticity. Possibly other manufacturers who are interested in clays could give an idea of what variety they are interested in, and in this way be informed when a clay that may meet their needs is received.

A total of 1134 samples were received and determined during the three month period covered by this report. A sample of pink andalusite from near the Julian District in San Diego County was one of those received having a mineralogical and possibly a commercial value.



LIBRARY.

FOREST L. CAMPBELL, Librarian.

In addition to the numerous standard works, authoritative information on many phases of the mining and mineral industry is constantly being issued in the form of reports and bulletins by various government agencies.

The library of the State Mining Bureau contains some five thousand selected volumes on mines, mining and allied subjects, and it is also a repository for reports and bulletins of the technical departments of federal and state governments and of educational institutions, both domestic and foreign.

It is not the dearth of the latter publications, but rather a lack of knowledge of just what has been published and where the reports may be consulted or obtained, that embarrasses the ordinary person seeking specific information.

To assist in making the public acquainted with this valuable source of current technical information, 'Mining in California' contains under this heading a list of all books and official reports and bulletins received, with names of publishers or issuing departments.

Files of all the leading technical journals will be found in the library, and county and state maps, topographical sheets and geological folios. Current copies of local newspapers published in the mining centers of the State are available for reference.

The library and reading room are open to the public during the usual office hours, when the librarian may be freely called upon for all necessary assistance.

OFFICIAL PUBLICATIONS RECEIVED.

Governmental.

U. S. Geological Survey:

Forty-sixth Annual Report of the Director of the Geological Survey to the Secretary of the Interior for the fiscal year ended June 30, 1925.

Professional Paper 136—The Flora of the Ripley Formation. By E. W. Berry.

Water Supply Paper 561—Surface Water Supply of the United States—Part I, North Atlantic Slope Drainage Basin.

Water Supply Paper 547—Lower Mississippi River Basin.

Water Supply Paper 556—Water Power and Flood Control of Colorado River Below Green River, Utah. By E. C. La Rue.

Water Supply Paper 560-D—Preliminary Report on the Geology and Water Resources of the Mud Lake Basin, Idaho. By H. T. Stearns.

Mineral Resources of the United States:

Arsenic in 1924.

Fluorspar and Cryolite in 1924.

Carbon Black Produced from Natural Gas in 1924.

Graphite in 1924.

Feldspar in 1924.

Potash in 1924.

Platinum in 1924.

Petroleum in 1923.

Phosphate Rock in 1924.

Magnesium and Its Compounds in 1924.

Clay in 1924.

Salt, Bromine and Calcium Chloride in 1924.

Slate in 1924.

Bulletin 767—Geology and Coal Resources of the Gallup-Zuni Basin, New Mexico. By J. D. Sears.

- Bulletin 771—Ore Deposits of the Saddle Mountain and Banner Mining Districts, Arizona. By C. P. Ross.
- Bulletin 773—Mineral Resources of Alaska in 1923. By A. H. Brooks.
- Bulletin 774—The Copper Deposits Near Salmon, Idaho. By Clyde P. Ross.
- Bulletin 777—Pre-Cambrian Rocks of Gunnison River, Colorado. By J. F. Hunter.
- Bulletin 778—Chemistry of Deposition of Native Copper from Ascending Solutions. By R. S. Wells.
- Bulletin 780-B—Geology of a Part of Western Texas and Southeastern New Mexico. By H. W. Hoots.
- U. S. Bureau of Mines:
- Technical paper 320—The Bureau of Mines Orsat Apparatus for Gas Analysis. By A. C. Fieldner.
- Technical Paper 367—Value of Bituminous Coal and Coke for Generating Steam in a Low Pressure Cast-iron Boiler. By C. E. Augustine.
- Technical Paper 343—Georgia and Alabama Clays as Fillers. By W. M. Weigel.
- Technical Paper 368—Paraffin Wax and Its Properties. By L. D. Wyant.
- Technical Paper 369—Mechanical Safeguards in Rotary Drilling. By H. C. Miller.
- Technical Paper 372—Silicosis Among Miners. By R. R. Sayers.
- Technical Paper 388—Coke Oven Accidents in the United States. By W. W. Adams.
- Technical Paper 346—Properties of Typical Crude Oils from the Producing Fields of the Western Hemisphere. By A. J. Kreamer.
- Bulletin No. 236—Plastic Magnesia. By O. C. Ralston.
- Bulletin No. 256—Garnet, Its Mining, Milling and Utilization. By W. M. Myers.
- Bulletin No. 257—Review of Safety and Health Conditions in the Mines at Butte. By G. S. Rice.
- Reports of Investigations:
- Serial No. 2709—Consumption of Reagents Used in Flotation, 1923-24. By Thomas Varley.
- Serial No. 2710—Gas Hazards in Street Manholes. By S. H. Katz, E. G. Meiter, and J. J. Bloomfield.
- Serial No. 2711—Falls of Roof and Coal in Bituminous Coal Mines. By W. W. Adams.
- Serial No. 2712—Temperature Control System for Dressing and Tempering Fishtail Bits. By Charles H. Shapiro.
- Serial No. 2713—Coal Mine Fatalities in September, 1925. By W. W. Adams.
- Serial No. 2714—Consumption of Explosives in September, 1925. By W. W. Adams.
- Serial No. 2715—Consumption of Explosives in August, 1925. By W. W. Adams.
- Serial No. 2716—Coal Mine Fatalities in October, 1925. By W. W. Adams.
- Serial No. 2717—Consumption of Explosives in October, 1925. By W. W. Adams.
- Serial No. 2718—Diatomaceous Earth (With Special Reference to Nevada). By C. W. Davis.
- Serial No. 2719—Gas Mask for Protection in Air Against all Gases, Vapors and Smokes. By A. C. Fieldner, S. H. Katz, H. W. Frevert, and E. G. Meiter.
- Serial No. 2720—List of Permissible Mining Equipment.
- Serial No. 2721—Evaporation Losses of Gasoline in the Refinery. By Ludwig Schmidt.
- Serial No. 2722—Coal Mine Fatalities in November, 1925. By W. W. Adams.
- Serial No. 2723—Consumption of Explosives in November, 1925. By W. W. Adams.
- Information Circulars:
- Circular No. 6000—The Legendary "White Metal" and Its "Ore." By C. W. Davis.
- U. S. Coast and Geodetic Survey: Triangulation in Maryland.

Smithsonian Institution:

Annual Report for 1924.

Report on the International Exchange Service for 1925.

National Research Council: Researches in Sedimentation in 1924.

U. S. Army: Annual Report of the Chief of Engineers, 1925.

Federal Power Commission: Fifth Annual Report, 1925.

Mint: Annual Report of the Director, 1925.

U. S. Department of Commerce: Annual Report of the Director, U. S. Coast and Geodetic Survey for the Fiscal Year ended June 30, 1925.

Alberta, Scientific and Industrial Research Council of—Report 14, Analyses of Alberta Coal.

Argentina, Ministerio de Agricultura de la Nacion:

Publication 5—Memoria de la Direccion General de Minas.

Publication 6—Informe sobre la Existencia de Mineral de Hierro en Los Alrededores Mayres de Potrerillos y Cachueta en la Provincia de Mendoza. By Roberto Beder.

Publication 7—Sobre los Rasgos Principales de la Glaciacion Actual en la Isla Laurie-Augusto Tapia.

Publication 8—Sobre la Estructura Tectonica de las Capas Petroliferas en el Oriente del Territorio del Nauquen. By J. Keidel.

Publication 9—Memoria de la Direccion General de Minas en 1923.

Publication 10—Informe Geologico Preliminar sobre el Yacimiento de Magnetita de la Mina "Sarmiento" Region de Characate Sierra de Cordoba.

Publication 11—Algunas Observaciones sobre el Yacimiento de Mineral de Hierro de la Mina "Romay" cerca de Albigasta, Provincia de Catamarca.

Great Britain Geological Survey:

Geological Sheets:

Romford.

Marlborough.

Map of the British Isles.

Scotland.

Vertical Section Sheet.

The Geology of the Country around Birmingham.

The Geology of the Country around Romford.

Scotland Geological Survey:

The Geology of the Country around Golspie, Sutherlandshire. By H. H. Read.

Economic Geology of the Ayrshire Coalfields, Area I—Dalry Saltcoats, Kilwinning and Kilmaurs. Area II—Kilmarnock Basin.

The Geology of the Glasgow District.

South Australia:

Annual Report of the Director of Mines and Government Geologist for 1924.

Department of Mines: No. 42—Mining Review of the year ended June 30, 1925.

Transvaal Chamber of Mines: 35th Annual Report, 1924.

Transvaal Economic Wage Commission:

Statement 1—Evidence of the Gold Producer's Committee of the Transvaal Chamber of Mines.

Statement 2—The Procedure by Which Wage Rates Are Settled and the Influence of Public Wage Regulation Upon Industrial Development.

Statement 3—The Terms of Reference to the Commission.

Statement 4—The Effect of Wage Rates Upon the Distribution of Labour Between Different Occupations.

Statement 5—To Consider the Effect of Different Wage and Labour Policies Upon the Opportunities at a Wage Compatible With a Civilized Standard of Life.

American Institute of Mining and Metallurgical Engineers:

Transactions Vol. LXXI.

Transactions Vol. LXXII.

Australian Museum, Records of the—Vol. XIV, No. 4.

British Museum:

Guide to the Fossil Plants in the Department of Geology and Palaeontology.
An Introduction to the Study of Minerals.

California Academy of Sciences: Vol. XIV, Nos. 1 to 17.

International Geological Congress: XIV Session Spain 1926.

Mining and Metallurgical Society of America:

Bulletin 179—Annual Business Meeting of New York Section.

Bulletins 180 and 181.

Illinois State Geological Survey:

Report of Investigations No. 6—Proper Testing for Oil Structures in Illinois and Some Areas Deserving Such Testing. By G. F. Moulton.

Report of Investigations No. 7—Further Contributions to the Geology of the Allendale Oil Field. By Gail P. Moulton.

Bulletin 29—Coal Resources of District 3 (Western Illinois).

Bulletin 30—Coal Losses in Illinois. By C. A. Allen.

Kansas State Geological Survey: Bulletin 10—The Geology of Russell County. By W. W. Ruby.

Kentucky Geological Survey:

Agricultural perspective of Kentucky Geology. By W. R. Jillson.

Series XI, Vol. 24—Geography of the Western Coal Fields. By W. G. Burroughs.

Nebraska State Museum: Bulletin 9—Tetrabelodon Abeli. By E. H. Barbour.

New Jersey Department of Conservation and Development: Bulletin 27—The Mineral Industry of New Jersey for 1924.

Ohio Geological Survey: 4th Series, Bulletin No. 29—Industrial Water Supplies of Ohio. By C. W. Foulk.

Oklahoma Geological Survey:

Bulletin 34—Geology of Cimarron County, Oklahoma. By E. P. Rothrock.

Bulletin 35—Index to the Stratigraphy of Oklahoma. By C. N. Gould.

Pennsylvania Topographic and Geologic Survey:

Bulletin M6, Part 4—Bituminous Coal Fields of Pennsylvania.

Bulletin M7—Limestones of Pennsylvania.

Pennsylvania Department of Forests and Waters: Bulletin MS—Anthracite losses and Reserves in Pennsylvania. By D. C. Ashmead.

Philippine Islands Bureau of Science: The Mineral Resources of the Philippine Islands for the years 1921, 1922 and 1923.

South Dakota Geological and Natural History Survey:

Circular 21—Sand and Gravel Deposits of Yankton County. By E. P. Rothrock.

Circular 24—The Ragged Butte Structure. By Roy A. Wilson.

Circular 18—Well Log in Northern Ziebach County. By W. L. Russell.

Circular 27—The Structure of Western South Dakota. By F. Ward.

Virginia Geological Survey: Bulletin XXVI—The Geology and Coal Resources of Lee County, Virginia. By A. W. Giles.

Wisconsin Geological Survey:

Bulletin 57—Phytoplankton of the Inland Lakes of Wisconsin. By G. M. Smith.

Bulletin 65—The Geography of Southwestern Wisconsin. By W. O. Blanchard.

Bulletin 66—Limestones and Marls of Wisconsin. By Edward Steitman.

Bulletin 67—A brief outline of the Geology, Physical Geography, Geography and Industries of Wisconsin. By W. O. Hotchkiss.

California, University of—Geology Department: Vol. 16, No. 1—Morphologic Features of the Basin Range District in the Great Basin. By George D. Louderback.

Kansas, University of: Engineering Bulletin No. 13—Kansas Coal. By C. M. Young.

Minnesota, University of: Bulletin 10—Ball Mill Crushing in Closed Circuit With Screens. By W. E. Davis.

Missouri, University of: Bibliography on zinc retorts and condensers. By B. M. O'Harra.

Pennsylvania State College:

Bulletin 33—An Investigation of Certain Methods for Testing Heat Insulators.
By E. F. Grundorfer.

Bulletin 34—Tests of Household Fuel Savers and the Economical Use of Coal.
By F. G. Hechler.

Maps.

Topographic Maps:

Burbank, California.
Paige, California.
Remnoy, California.
Visalia, California.
Covelo, California.
Riverdale, California.
Burrel, California.
Traver, California.
Laton, California.
Monson, California.
Exeter, California.
Cairns Corner, California.

Current Magazines on File.

For the convenience of persons wishing to consult the technical magazines in the reading room, a list of those on file is appended:

American Petroleum Institute, New York.
Architect and Engineer, San Francisco.
Arizona Mining Journal, Phoenix, Arizona.
Asbestos, Philadelphia, Pennsylvania.
Brick and Clay Record, Chicago.
Bulletin, Union Oil Co., Los Angeles.
California Journal of Development, San Francisco.
Cement, Mill and Quarry, Chicago, Illinois.
Chemical Engineering and Mining Review, London, England.
Engineering and Mining Journal-Press, New York.
Explosives Engineer, Wilmington, Del.
Financial Insurance News, Los Angeles, California.
Graphite, Jersey City.
Journal of Electricity and Western Industry, San Francisco.
Metallurgical and Chemical Engineering, New York.
Mine and Quarry, Chicago.
Mining and Engineering Record, Vancouver, B. C.
Mining and Oil Bulletin, Los Angeles.
Oil Age, Los Angeles.
Oil and Gas Journal, Tulsa, Oklahoma.
Oil and Gas News, Kansas City.
Oil News, Galesburg, Illinois.
Oildom, New York.
Oil, Paint and Drug Reporter, New York.
Oil Trade Journal, New York.
Oil Weekly, Houston, Texas.
Petroleum Age, New York.
Petroleum Record, Los Angeles.
Petroleum World, Los Angeles.
Queensland Government Mining Journal, Brisbane, Australia.
Rock Products, Chicago, Illinois.
Safety News, Industrial Accident Commission, San Francisco.
Salt Lake Mining Review, Salt Lake City, Utah.
Southwest Builder and Contractor, Los Angeles.
Standard Oil Bulletin, San Francisco.
Stone, New York.
The Record, Associated Oil Company, San Francisco.
Through the Ages, Baltimore.

Newspapers.

The following papers are received and kept on file in the library:

Amador Dispatch, Jackson, Cal.
Arkansas Oil and Mineral News, Hot Springs National Park (Arkansas).
Barstow Printer, Barstow, Cal.
Blythe Herald, Blythe, Cal.
Bridgeport Chronicle-Union, Bridgeport, Mono Co., Cal.
Calaveras Prospect, San Andreas, Cal.
California Oil World, Los Angeles, Cal.
Cloverdale Reveille, Cloverdale, Cal.
Colusa Daily Sun, Colusa, Cal.
Daily Commercial News, San Francisco, Cal.
Daily Midway Driller, Taft, Cal.
Del Norte Triplicate, Crescent City, Cal.
Exeter Sun, Exeter, Cal.
Gateway Gazette, Beaumont, Cal.
Goldfield News, Goldfield, Nevada.
Guerneville Times, Guerneville, Cal.
Healdsburg Enterprise, Healdsburg, Cal.
Humboldt Standard, Eureka, Cal.
Inyo Independent, Independence, Cal.
Inyo Register, Bishop, Cal.
Ione Valley Echo, Ione, Cal.
Lake County Bee, Lakeport, Cal.
Mining and Financial Record, Denver, Colo.
Mining Topics, San Francisco, Cal.
Mountain Democrat, Placerville, Cal.
Mountain Messenger, Downieville, Cal.
Nevada Mining Press, Reno, Nevada.
Oatman Mining News, Oatman, Arizona.
Oregon Observer, Grants Pass, Oregon.
Oroville Daily Register, Oroville, Cal.
Petroleum Reporter, Taft, Cal.
Placer Herald, Auburn, Cal.
Plumas Independent, Quincy, Cal.
Plumas National Bulletin, Quincy, Cal.
Randsburg Times, Randsburg, Cal.
San Diego News, San Diego, Cal.
Shasta Courier, Redding, Cal.
Siskiyou News, Yreka, Cal.
Stockton Record, Stockton, Cal.
Tuolumne Prospector, Tuolumne, Cal.
Ventura Daily Post, Ventura, Cal.
Weekly Trinity Journal, Weaverville, Cal.
Western Sentinel, Etna Mills, Cal.



PRODUCERS AND CONSUMERS.

The producer and consumer of mineral products are mutually dependent upon each other for their prosperity, and one of the most direct aids rendered by the Bureau to the mining industry in the past has been that of bringing producers and consumers into direct touch with each other.

This work has been carried on largely by correspondence, supplemented by personal consultation. Lists of buyers of all the commercial minerals produced in California have been made available to producers upon request, and likewise the owners of undeveloped deposits of various minerals, and producers of them, have been made known to those looking for raw mineral products.

When the publication of MINING IN CALIFORNIA was on a monthly basis, current inquiries from buyers and sellers were summarized and lists of mineral products or deposits 'wanted' or 'for sale' included in each issue.

It is important that inquiries of this nature reach the mining public as soon as possible and in order to avoid the delay incident to the present quarterly publication of MINING IN CALIFORNIA, these lists are now issued monthly in the form of a mimeographed sheet under the title of 'Commercial Mineral Notes.'



EMPLOYMENT SERVICE.

Following the establishment of the Mining Division branch offices in 1919, a free technical employment service was offered as a mutual aid to mine operators and technical men for the general benefit of the mineral industry.

Briefly summarized, men desiring positions are registered, the cards containing an outline of the applicant's qualifications, position wanted, salary desired, etc., and as notices of 'positions open' are received, the names and addresses of all applicants deemed qualified are sent to the prospective employer for direct negotiations.

Telephone and telegraphic communications are also given immediate attention.

The Bureau registers technical men, or those qualified for supervisory positions, and vacancies of like nature, only, as no attempt will be made to supply common mine and mill labor.

A list of current applications for positions and 'positions open' is carried in each issue. Notices are designated by a key number, and the name and address corresponding to any number will be supplied upon request, without delay or charge of any kind. If desired, recommendations may be filed with an application, but copies only should be sent to the Bureau, to avoid possible loss. Registration cards for the use of both prospective employers and employees may be obtained at any office of the Bureau upon request, and a cordial invitation is extended to the industry to make free use of the facilities afforded.

POSITIONS WANTED.

- 41-1 Consulting work. Power cost, rate and schedule problems; design, specifications, estimating and reports.
- 41-2 Technical Librarian. Late technical librarian, Central Mining Rand Mines, Ltd., Johannesburg.
- 41-3 Mining Engineer. Leaching ores especially. Four and one-half years' experience. Age 30. Single.
- 41-4 Company Physician and Surgeon. Graduate Cooper Medical School. Fourteen years' experience. Prefer southwest.
- 41-5 Coal Mine Manager. Developing coal mines. Twenty-five years' experience.
- 41-6 Mine Superintendent. Long and varied experience. Age 49. Married. References.
- 41-7 Underground Foreman. Fifteen years' foreign experience. Age 44. Married. References.



PUBLICATIONS OF THE CALIFORNIA STATE MINING BUREAU.

During the past forty-four years, in carrying out the provisions of the organic act creating the California State Mining Bureau, there have been published many reports, bulletins and maps which go to make up a library of detailed information on the mineral industry of the state, a large part of which could not be duplicated from any other source.

One feature that has added to the popularity of the publications is that many of them have been distributed without cost to the public, and even the more elaborate ones have been sold at a price which barely covers the cost of printing.

Owing to the fact that funds for the advancing of the work of this department have often been limited, many of the reports and bulletins mentioned were printed in limited editions which are now entirely exhausted.

Copies of such publications are available, however, in the Bureau's offices in the Ferry Building, San Francisco; Sun Finance Building, Los Angeles; Chamber of Commerce Building, Sacramento; Santa Maria; Santa Paula; Coalinga; Taft; Bakersfield. They may also be found in many public, private and technical libraries in California and other states, and foreign countries.

A catalog of all publications of the Bureau, from 1880 to 1917, giving a synopsis of their contents, is issued as Bulletin No. 77.

Publications in stock may be obtained by addressing any of the offices of the State Mining Bureau and enclosing the requisite amount in the case of publications that have a list price. The Bureau is authorized to receive only coin, stamps or money orders, and it will be appreciated if remittance is made in this manner rather than by personal check.

The prices noted include delivery charges to all parts of the United States. Money orders should be made payable to the State Mining Bureau.

REPORTS.

Asterisks (**) indicate the publication is out of print.

	Price
**First Annual Report of the State Mineralogist, 1880, 43 pp. Henry G. Hanks -----	-----
**Second Annual Report of the State Mineralogist, 1882, 514 pp., 4 illustrations, 1 map. Henry G. Hanks-----	-----
**Third Annual Report of the State Mineralogist, 1883, 111 pp., 21 illustrations. Henry G. Hanks-----	-----
**Fourth Annual Report of the State Mineralogist, 1884, 410 pp., 7 illustrations. Henry G. Hanks-----	-----
**Fifth Annual Report of the State Mineralogist, 1885, 234 pp., 15 illustrations, 1 geological map. Henry G. Hanks-----	-----
**Sixth Annual Report of the State Mineralogist, Part I, 1886, 145 pp., 3 illustrations, 1 map. Henry G. Hanks-----	-----
**Part II, 1887, 222 pp., 36 illustrations. William Ireland, Jr.-----	-----
**Seventh Annual Report of the State Mineralogist, 1887, 315 pp. William Ireland, Jr. -----	-----
**Eighth Annual Report of the State Mineralogist, 1888, 948 pp., 122 illustrations. William Ireland, Jr.-----	-----
**Ninth Annual Report of the State Mineralogist, 1889, 352 pp., 57 illustrations, 2 maps. William Ireland, Jr.-----	-----

REPORTS—Continued.

Asterisks (**) indicate the publication is out of print.

	Price
**Tenth Annual Report of the State Mineralogist, 1890, 983 pp., 179 illustrations, 10 maps. William Irelan, Jr.-----	----
Eleventh Report (First Biennial) of the State Mineralogist, for the two years ending September 15, 1892, 612 pp., 73 illustrations, 4 maps. William Irelan, Jr.-----	\$1.00
**Twelfth Report (Second Biennial) of the State Mineralogist, for the two years ending September 15, 1894, 541 pp., 101 illustrations, 5 maps. J. J. Crawford-----	----
**Thirteenth Report (Third Biennial) of the State Mineralogist, for the two years ending September 15, 1896, 726 pp., 93 illustrations, 1 map. J. J. Crawford-----	----
Chapters of the State Mineralogist's Report, Biennial Period, 1913-1914, Fletcher Hamilton:	
**Mines and Mineral Resources, Amador, Calaveras and Tuolumne Counties, 172 pp., paper-----	----
Mines and Mineral Resources, Colusa, Glenn, Lake, Marin, Napa, Solano, Sonoma and Yolo Counties, 208 pp., paper-----	.50
Mines and Mineral Resources, Del Norte, Humboldt, and Mendocino Counties, 59 pp., paper-----	.25
**Mines and Mineral Resources, Fresno, Kern, Kings, Madera, Mariposa, Merced, San Joaquin and Stanislaus Counties, 220 pages, paper-----	----
Mines and Mineral Resources of Imperial and San Diego Counties, 113 pp., paper-----	.35
**Mines and Mineral Resources, Shasta, Siskiyou and Trinity Counties, 180 pp., paper-----	----
Fourteenth Report of the State Mineralogist, for the Biennial Period 1913-1914, Fletcher Hamilton, 1915:	
A General Report on the Mines and Mineral Resources of Amador, Calaveras, Tuolumne, Colusa, Glenn, Lake, Marin, Napa, Solano, Sonoma, Yolo, Del Norte, Humboldt, Mendocino, Fresno, Kern, Kings, Madera, Mariposa, Merced, San Joaquin, Stanislaus, San Diego, Imperial, Shasta, Siskiyou, and Trinity Counties, 974 pp., 275 illustrations, cloth-----	2.00
Chapters of the State Mineralogist's Report, Biennial Period, 1915-1916, Fletcher Hamilton:	
**Mines and Mineral Resources, Alpine, Inyo and Mono Counties, 176 pp., paper-----	----
**Mines and Mineral Resources, Butte, Lassen, Modoc, Sutter, and Tehama Counties, 91 pp., paper-----	----
Mines and Mineral Resources, El Dorado, Placer, Sacramento, and Yuba Counties, 198 pp., paper-----	.65
Mines and Mineral Resources, Monterey, San Benito, San Luis Obispo, Santa Barbara, and Ventura Counties, 183 pp., paper-----	.65
Mines and Mineral Resources, Los Angeles, Orange, and Riverside Counties, 136 pp., paper-----	.50
**Mines and Mineral Resources, San Bernardino and Tulare Counties, 186 pp., paper-----	----
Fifteenth Report of the State Mineralogist, for the Biennial Period 1915-1916, Fletcher Hamilton, 1917:	
A General Report on the Mines and Mineral Resources of Alpine, Inyo, Mono, Butte, Lassen, Modoc, Sutter, Tehama, Placer, Sacramento, Yuba, Los Angeles, Orange, Riverside, San Benito, San Luis Obispo, Santa Barbara, Ventura, San Bernardino and Tulare Counties, 990 pp., 413 illustrations, cloth-----	3.75
Chapters of the State Mineralogist's Report, Biennial Period 1917-1918, Fletcher Hamilton:	
Mines and Mineral Resources of Nevada County, 270 pp., paper-----	.75
Mines and Mineral Resources of Plumas County, 188 pp., paper-----	.50
Mines and Mineral Resources of Sierra County, 144 pp., paper-----	.50
Seventeenth Report of the State Mineralogist, 1920, Mining in California during 1920, Fletcher Hamilton; 562 pp., 71 illustrations, cloth-----	1.75

REPORTS—Continued.

Asterisks (**) indicate the publication is out of print.

	Price
Eighteenth Report of the State Mineralogist, 1922, Mining in California, Fletcher Hamilton. Chapters published monthly beginning with January, 1922:	
**January, **February, March, April, May, June, July, August, September, October, November, December, 1922-----	Free
Chapters of Nineteenth Report of the State Mineralogist, 'Mining in California,' Fletcher Hamilton and Lloyd L. Root. January, February, March, September, 1923-----	Free
Chapters of Twentieth Report of the State Mineralogist, 'Mining in California,' Lloyd L. Root. Published quarterly. January, April, July, October, 1924, per copy-----	\$0.25
Chapters of Twenty-first Report of the State Mineralogist, 'Mining in California,' Lloyd L. Root. Published quarterly, January, April, July, October, 1925, per copy-----	.25
Subscription, \$1.00 in advance (by calendar year, only).	
Chapters of State Oil and Gas Supervisor's Report:	
Summary of Operations—California Oil Fields, July, 1918, to March, 1919 (one volume)-----	Free
Summary of Operations—California Oil Fields. Published monthly, beginning April, 1919:	
**April, **May, June, **July, **August, **September, **October, November, **December, 1919-----	Free
January, February, March, April, **May, June, July, **August, September, October, November, December, 1920-----	Free
January, **February, **March, **April, May, June, **July, August, **September, **October, **November, **December, 1921-----	Free
January, February, March, April, May, June, July, August, September, October, November, December, 1922-----	Free
January, February, March, April, May, June, July, August, September, October, November, December, 1923-----	Free
January, February, March, April, May, June, July, August, September, October, November, December, 1924-----	Free
January, February, March, April, May, June, July, August, September, October, 1925-----	Free

BULLETINS.

Asterisks (**) indicate the publication is out of print.

**Bulletin No. 1. A Description of Some Desiccated Human Remains, by Winslow Anderson. 1888, 41 pp., 6 illustrations-----	
**Bulletin No. 2. Methods of Mine Timbering, by W. H. Storms. 1894, 58 pp., 75 illustrations-----	
**Bulletin No. 3. Gas and Petroleum Yielding Formations of Central Valley of California, by W. L. Watts. 1894, 100 pp., 13 illustrations, 4 maps-----	
**Bulletin No. 4. Catalogue of Californian Fossils, by J. G. Cooper, 1894, 73 pp., 67 illustrations. (Part I was published in the Seventh Annual Report of the State Mineralogist, 1887.)-----	
**Bulletin No. 5. The Cyanide Process, 1894, by Dr. A. Scheidel. 140 pp., 46 illustrations-----	
Bulletin No. 6. California Gold Mill Practices, 1895, by E. B. Preston, 85 pp., 46 illustrations-----	.50
**Bulletin No. 7. Mineral Production of California, by Counties for the year 1894, by Charles G. Yale. Tabulated sheet-----	
**Bulletin No. 8. Mineral Production of California, by Counties for the year 1895, by Charles G. Yale. Tabulated sheet-----	
**Bulletin No. 9. Mine Drainage, Pumps, etc., by Hans C. Behr. 1896, 210 pp., 206 illustrations-----	
**Bulletin No. 10. A bibliography Relating to the Geology, Palæontology and Mineral Resources of California, by Anthony W. Vogdes. 1896, 121 pp.-----	
**Bulletin No. 11. Oil and Gas Yielding Formations of Los Angeles, Ventura and Santa Barbara counties, by W. L. Watts. 1897, 94 pp., 6 maps, 31 illustrations-----	

BULLETINS—Continued.

Asterisks (**) indicate the publication is out of print.

	Price
**Bulletin No. 12. Mineral Production of California, by Counties for 1896, by Charles G. Yale. Tabulated sheet-----	-----
**Bulletin No. 13. Mineral Production of California, by Counties for 1897, by Charles G. Yale. Tabulated sheet-----	-----
**Bulletin No. 14. Mineral Production of California, by Counties for 1898, by Charles G. Yale-----	-----
**Bulletin No. 15. Map of Oil City Fields, Fresno County, by John H. Means. 1899-----	-----
**Bulletin No. 16. The Genesis of Petroleum and Asphaltum in California, by A. S. Cooper. 1899, 39 pp., 29 illustrations-----	-----
**Bulletin No. 17. Mineral Production of California, by Counties for 1899, by Charles G. Yale. Tabulated sheet-----	-----
**Bulletin No. 18. Mother Lode Region of California, by W. H. Storms. 1900, 154 pp., 49 illustrations-----	-----
**Bulletin No. 19. Oil and Gas Yielding Formations of California, by W. L. Watts. 1900, 236 pp., 60 illustrations, 8 maps-----	-----
**Bulletin No. 20. Synopsis of General Report of State Mining Bureau, by W. L. Watts. 1901, 21 pp. This bulletin contains a brief statement of the progress of the mineral industry in California for the four years ending December, 1899-----	-----
**Bulletin No. 21. Mineral Production of California by Counties, by Charles G. Yale. 1900. Tabulated sheet-----	-----
**Bulletin No. 22. Mineral Production of California for Fourteen Years, by Charles G. Yale. 1900. Tabulated sheet-----	-----
Bulletin No. 23. The Copper Resources of California, by P. C. DuBois, F. M. Anderson, J. H. Tibbits and G. A. Tweedy. 1902, 282 pp., 69 illustrations, and 9 maps-----	\$0.50
**Bulletin No. 24. The Saline Deposits of California, by G. E. Bailey. 1902, 216 pp., 99 illustrations, 5 maps-----	-----
**Bulletin No. 25. Mineral Production of California, by Counties, for 1901, by Charles G. Yale. Tabulated sheet-----	-----
**Bulletin No. 26. Mineral Production of California for the past Fifteen Years, by Charles G. Yale. 1902. Tabulated sheet-----	-----
**Bulletin No. 27. The Quicksilver Resources of California, by William Forstner. 1903, 273 pp., 144 illustrations, 8 maps-----	-----
**Bulletin No. 28. Mineral Production of California, for 1902, by Charles G. Yale. Tabulated sheet-----	-----
**Bulletin No. 29. Mineral Production of California for Sixteen Years, by Charles G. Yale. 1903. Tabulated sheet-----	-----
**Bulletin No. 30. Bibliography Relating to the Geology, Palæontology, and Mineral Resources of California, by A. W. Vogdes. 1903, 290 pp.-----	-----
**Bulletin No. 31. Chemical Analyses of California Petroleum, by H. N. Cooper. 1904. Tabulated sheet-----	-----
**Bulletin No. 32. Production and Use of Petroleum in California, by Paul W. Prutzman. 1904, 230 pp., 116 illustrations, 14 maps-----	-----
**Bulletin No. 33. Mineral Production of California, by Counties, for 1903, by Charles G. Yale. Tabulated sheet-----	-----
**Bulletin No. 34. Mineral Production of California for Seventeen Years, by Charles G. Yale. 1904. Tabulated sheet-----	-----
**Bulletin No. 35. Mines and Minerals of California, by Charles G. Yale. 1904, 55 pp., 20 county maps. Relief map of California-----	-----
**Bulletin No. 36. Gold Dredging in California, by J. E. Doolittle. 1905, 120 pp., 66 illustrations, 3 maps-----	-----
**Bulletin No. 37. Gems, Jewelers' Materials, and Ornamental Stones of California, by George F. Kunz. 1905, 168 pp., 54 illustrations-----	-----
**Bulletin No. 38. Structural and Industrial Materials of California, by Wm. Forstner, T. C. Hopkins, C. Naramore and L. H. Eddy. 1906, 412 pp., 150 illustrations, 1 map-----	-----
**Bulletin No. 39. Mineral Production of California, by Counties, for 1904, by Charles G. Yale. Tabulated sheet-----	-----
**Bulletin No. 40. Mineral Production of California for Eighteen Years, by Charles G. Yale. 1905. Tabulated sheet-----	-----

BULLETINS—Continued.

Asterisks (**) indicate the publication is out of print.

	Price
**Bulletin No. 41. Mines and Minerals of California, for 1904, by Charles G. Yale. 1905, 54 pp., 20 county maps-----	-----
**Bulletin No. 42. Mineral Production of California, by Counties, 1905, by Charles G. Yale. Tabulated sheet-----	-----
**Bulletin No. 43. Mineral Production of California for Nineteen Years, by Charles G. Yale. Tabulated sheet-----	-----
**Bulletin No. 44. California Mines and Minerals for 1905, by Charles G. Yale. 1907, 31 pp., 20 county maps-----	-----
**Bulletin No. 45. Auriferous Black Sands of California, by J. A. Edman. 1907. 10 pp.-----	-----
Bulletin No. 46. General Index of Publications of the California State Mining Bureau, by Charles G. Yale. 1907, 54 pp.-----	\$0.30
**Bulletin No. 47. Mineral Production of California, by Counties, 1906, by Charles G. Yale. Tabulated sheet-----	-----
**Bulletin No. 48. Mineral Production of California for Twenty Years. 1906, by Charles G. Yale-----	-----
**Bulletin No. 49. Mines and Minerals of California for 1906, by Charles G. Yale. 34 pp.-----	-----
Bulletin No. 50. The Copper Resources of California, 1908, by A. Hausmann, J. Kruttschnitt, Jr., W. E. Thorne and J. A. Edman, 366 pp., 74 illustrations. (Revised edition.)-----	1.00
**Bulletin No. 51. Mineral Production of California, by Counties, 1907, by D. H. Walker. Tabulated sheet-----	-----
**Bulletin No. 52. Mineral Production of California for Twenty-one Years, 1907, by D. H. Walker. Tabulated sheet-----	-----
**Bulletin No. 53. Mineral Production of California for 1907, with County Maps, by D. H. Walker, 62 pp.-----	-----
**Bulletin No. 54. Mineral Production of California, by Counties, by D. H. Walker, 1908. Tabulated sheet-----	-----
**Bulletin No. 55. Mineral Production of California for Twenty-two Years, by D. H. Walker, 1908. Tabulated sheet-----	-----
**Bulletin No. 56. Mineral Production for 1908, with County Maps and Mining Laws of California, by D. H. Walker. 78 pp.-----	-----
**Bulletin No. 57. Gold Dredging in California, by W. B. Winston and Chas. Janin. 1910, 312 pp., 239 illustrations and 10 maps-----	-----
**Bulletin No. 58. Mineral Production of California, by Counties, by D. H. Walker, 1909. Tabulated sheet-----	-----
**Bulletin No. 59. Mineral Production of California for Twenty-three Years, by D. H. Walker, 1909. Tabulated sheet-----	-----
**Bulletin No. 60. Mineral Production for 1909, County Maps and Mining Laws of California, by D. H. Walker. 94 pp.-----	-----
**Bulletin No. 61. Mineral Production of California, by Counties for 1910, by D. H. Walker. Tabulated sheet-----	-----
**Bulletin No. 62. Mineral Production of California for Twenty-four Years, by D. H. Walker, 1910. Tabulated sheet-----	-----
**Bulletin No. 63. Petroleum in Southern California, by P. W. Prutzman. 1912, 430 pp., 41 illustrations, 6 maps-----	-----
**Bulletin No. 64. Mineral Production for 1911, by E. S. Boalich. 49 pp.-----	-----
**Bulletin No. 65. Mineral Production for 1912, by E. S. Boalich. 64 pp.-----	-----
**Bulletin No. 66. Mining Laws of the United States and California. 1914, 89 pp.-----	-----
**Bulletin No. 67. Minerals of California, by Arthur S. Eakle. 1914, 226 pp.-----	-----
**Bulletin No. 68. Mineral Production for 1913, with County Maps and Mining Laws, by E. S. Boalich. 160 pp.-----	-----
**Bulletin No. 69. Petroleum Industry of California, with Folio of Maps (18 by 22), by R. P. McLaughlin and C. A. Waring. 1914, 519 pp., 13 illustrations, 83 figs. [18 plates in accompanying folio.]-----	-----
**Bulletin No. 70. Mineral Production for 1914, with County Maps and Mining Laws. 184 pp.-----	-----
**Bulletin No. 71. Mineral Production for 1915, with County Maps and Mining Laws, by Walter W. Bradley. 193 pp., 4 illustrations-----	-----

BULLETINS—Continued.

	Price
Bulletin No. 72. The Geologic Formations of California, by James Perrin Smith. 1916, 47 pp.-----	\$0.25
Reconnaissance Geologic Map (of which, Bulletin 72 is explanatory), in 23 colors. Scale: 1 inch equals 12 miles. Mounted-----	2.50
**Bulletin No. 73. First Annual Report of the State Oil and Gas Supervisor of California, for the fiscal year 1915-16, by R. P. McLaughlin. 278 pp., 26 illustrations-----	---
Bulletin No. 74. Mineral Production of California in 1916, with County Maps, by Walter W. Bradley. 179 pp., 12 illustrations-----	Free
**Bulletin No. 75. United States and California Mining Laws, 1917. 115 pp., paper-----	---
Bulletin No. 76. Manganese and Chromium in California, by Walter W. Bradley, Emile Huguenin, C. A. Logan, W. B. Tucker and C. A. Waring, 1918. 248 pp., 51 illustrations, 5 maps, paper-----	.50
Bulletin No. 77. Catalogue of Publications of California State Mining Bureau, 1880-1917, by E. S. Boalich. 44 pp., paper-----	Free
Bulletin No. 78. Quicksilver Resources of California, with a Section on Metallurgy and Ore-Dressing, by Walter W. Bradley, 1918. 389 pp., 77 photographs and 42 plates (colored and line cuts), cloth-----	1.50
Bulletin No. 79. Magnesite in California, by Walter W. Bradley, 1925, 147 pp., 62 photographs, 11 line cuts and maps, cloth-----	1.00
Bulletin No. 80. Tungsten, Molybdenum and Vanadium in California. (In preparation.)-----	---
Bulletin No. 81. Foothill Copper Belt of California. (In preparation.)-----	---
**Bulletin No. 82. Second Annual Report of the State Oil and Gas Supervisor, for the fiscal year 1916-1917, by R. P. McLaughlin, 1918. 412 pp., 31 illustrations, cloth-----	---
Bulletin No. 83. California Mineral Production for 1917, with County Maps, by Walter W. Bradley. 179 pp., paper-----	Free
**Bulletin No. 84. Third Annual Report of the State Oil and Gas Supervisor, for the fiscal year 1917-1918, by R. P. McLaughlin, 1918. 617 pp., 28 illustrations, cloth-----	---
**Bulletin No. 85. Platinum and Allied Metals in California, by C. A. Logan, 1919. 10 photographs, 4 plates, 120 pp., paper-----	---
Bulletin No. 86. California Mineral Production for 1918, with County Maps, by Walter W. Bradley, 1919. 212 pp., paper-----	Free
**Bulletin No. 87. Commercial Minerals of California, with notes on their uses, distribution, properties, ores, field tests, and preparation for market, by W. O. Castello, 1920. 124 pp., paper-----	---
Bulletin No. 88. California Mineral Production for 1919, with County Maps, by Walter W. Bradley, 1920. 204 pp., paper-----	Free
**Bulletin No. 89. Petroleum Resources of California, with Special Reference to Unproved Areas, by Lawrence Vander Leek, 1921. 12 figures, 6 photographs, 6 maps in pocket, 186 pp., cloth-----	---
Bulletin No. 90. California Mineral Production for 1920, with County Maps, by Walter W. Bradley, 1921. 218 pp., paper-----	Free
Bulletin No. 91. Minerals of California, by Arthur S. Eakle, 1923, 328 pp., cloth-----	1.00
Bulletin No. 92. Gold Placers of California, by Chas. S. Haley, 1923. 167 pp., 36 photographs and 7 plates (colored and line cuts, also geologic map), cloth-----	1.50
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PRELIMINARY REPORTS.

Asterisks (**) indicate the publication is out of print.

Price

**Preliminary Report No. 1. Notes on Damage by Water in California Oil Fields, December, 1913. By R. P. McLaughlin. 4 pp.-----	----
**Preliminary Report No. 2. Notes on Damage by Water in California Oil Fields, March, 1914. By R. P. McLaughlin. 4 pp.-----	----
Preliminary Report No. 3. Manganese and Chromium, 1917. By E. S. Boalich. 32 pp.-----	----
Preliminary Report No. 4. Tungsten, Molybdenum and Vanadium. By E. S. Boalich and W. O. Castello, 1918. 34 pp. Paper-----	Free
Preliminary Report No. 5. Antimony, Graphite, Nickel, Potash, Strontium and Tin. By E. S. Boalich and W. O. Castello, 1918. 44 pp. Paper---	Free
**Preliminary Report No. 6. A Review of Mining in California During 1919. Fletcher Hamilton, 1920. 43 pp. Paper-----	----
**Preliminary Report No. 7. The Clay Industry in California. By E. S. Boalich, W. O. Castello, E. Huguenin, C. A. Logan, and W. B. Tucker, 1920. 102 pp. 24 illustrations. Paper-----	----
**Preliminary Report No. 8. A Review of Mining in California During 1921, with Notes on the Outlook for 1922. Fletcher Hamilton, 1922. 68 pp. Paper-----	----

MISCELLANEOUS PUBLICATIONS.

Asterisks (**) indicate the publication is out of print.

**First Annual Catalogue of the State Museum of California, being the collection made by the State Mining Bureau during the year ending April 16, 1881. 350 pp.-----	----
**Catalogue of books, maps, lithographs, photographs, etc., in the library of the State Mining Bureau at San Francisco, May 15, 1884. 19 pp.-----	----
**Catalogue of the State Museum of California, Volume II, being the collection made by the State Mining Bureau from April 16, 1881, to May 5, 1884. 220 pp.-----	----
**Catalogue of the State Museum of California, Volume III, being the collection made by the State Mining Bureau from May 15, 1884, to March 31, 1887. 195 pp.-----	----
**Catalogue of the State Museum of California, Volume IV, being the collection made by the State Mining Bureau from March 30, 1887, to August 20, 1890. 261 pp.-----	----
**Catalogue of the Library of the California State Mining Bureau, September 1, 1892. 149 pp.-----	----
**Catalogue of West North American and Many Foreign Shells with Their Geographical Ranges, by J. G. Cooper. Printed for the State Mining Bureau, April, 1894.-----	----
**Report of the Board of Trustees for the four years ending September, 1900. 15 pp. Paper-----	----
Bulletin. Reconnaissance of the Colorado Desert Mining District. By Stephen Bowers, 1901. 19 pp. 2 illustrations. Paper-----	Free
Commercial Mineral Notes. A monthly mimeographed sheet, beginning April, 1923.-----	Free

MAPS.

Registers of Mines With Maps.

Asterisks (**) indicate out of print.

**Register of Mines, with Map, Amador County -----	----
**Register of Mines, with Map, Butte County -----	----
**Register of Mines, with Map, Calaveras County -----	----
**Register of Mines, with Map, El Dorado County -----	----
**Register of Mines, with Map, Inyo County -----	----
**Register of Mines, with Map, Kern County -----	----
**Register of Mines, with Map, Lake County -----	----
**Register of Mines, with Map, Mariposa County -----	----
**Register of Mines, with Map, Nevada County -----	----
**Register of Mines, with Map, Placer County -----	----
**Register of Mines, with Map, Plumas County -----	----
**Register of Mines, with Map, San Bernardino County -----	----

MAPS—Continued.

Asterisks (**) indicate the publication is out of print.

	Price
**Register of Mines, with Map, San Diego County-----	
Register of Mines, with Map, Santa Barbara County-----	\$0.25
**Register of Mines, with Map, Shasta County-----	
**Register of Mines, with Map, Sierra County-----	
**Register of Mines, with Map, Siskiyou County-----	
**Register of Mines, with Map, Trinity County-----	
**Register of Mines, with Map, Tuolumne County-----	
Register of Mines, with Map, Yuba County-----	
Register of Oil Wells, with Map, Los Angeles City-----	

OTHER MAPS.

Asterisks (**) indicate the publication is out of print.

**Map of California. Showing Mineral Deposits (50 x 60 in.)—	
Map of Forest Reserves in California—	
Mounted-----	.50
**Unmounted-----	
**Mineral and Relief Map of California-----	
**Map of El Dorado County, Showing Boundaries, National Forests-----	
**Map of Madera County, Showing Boundaries, National Forests-----	
**Map of Placer County, Showing Boundaries, National Forests-----	
**Map of Shasta County, Showing Boundaries, National Forests-----	
**Map of Sierra County, Showing Boundaries, National Forests-----	
**Map of Siskiyou County, Showing Boundaries, National Forests-----	
**Map of Tuolumne County, Showing Boundaries, National Forests-----	
**Map of Mother Lode Region-----	
**Map of Desert Region of Southern California-----	
Map of Minaret District, Madera County-----	.20
Map of Copper Deposits in California-----	.05
**Map of Calaveras County-----	
**Map of Plumas County-----	.25
**Map of Trinity County-----	
**Map of Tuolumne County-----	
Geological Map of Inyo County. Scale 1 inch equals 4 miles-----	.60
Map of California accompanying Bulletin No. 89, showing generalized classification of land with regard to oil possibilities. Map only, without Bulletin-----	.25
Geological Map of California, 1916. Scale 1 inch equals 12 miles. As accurate and up-to-date as available data will permit as regards topography and geography. Shows railroads, highways, post offices and other towns. First geological map that has been available since 1892, and shows geology of entire state as no other map does. Geological details lithographed in 23 colors. Mounted-----	2.50
Topographic Map of Sierra Nevada Gold Belt, showing distribution of auriferous gravels. In 4 colors-----	.50

OIL FIELD MAPS.

These maps are revised from time to time as development work advances and ownerships change.

Map No. 1—Sargent, Santa Clara County-----	.50
Map No. 2—Santa Maria, including Cat Canyon and Los Alamos-----	.75
Map No. 3—Santa Maria, including Casmalia and Lompoc-----	.75
Map No. 4—Whittier-Fullerton, including Olinda, Brea Canyon, Puente Hills, East Coyote and Richfield-----	.75
Map No. 5—Whittier-Fullerton, including Whittier, West Coyote, and Montebello-----	.75
Map No. 6—Salt Lake, Los Angeles County-----	.75
Map No. 7—Sunset and San Emido and Kern County-----	.75
Map No. 8—South Midway and Buena Vista Hills, Kern County-----	.75
Map No. 9—North Midway and McKittrick, Kern County-----	.75
Map No. 10—Belridge and McKittrick, Kern County-----	.75

OIL FIELD MAPS—Continued.

	Price
Map No. 11—Lost Hills and North Belridge, Kern County.....	.75
Map No. 12—Devils Den, Kern County.....	.75
Map No. 13—Kern River, Kern County.....	\$0.75
Map No. 14—Coalinga, Fresno County.....	1.00
Map No. 15—Elk Hills, Kern County.....	.75
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Map No. 17—Santa Paula-Sespe Oil Fields, Ventura County.....	.75
Map No. 18—Piru-Simi-Newhall Oil Fields.....	.75
Map No. 19—Arroyo Grande, San Luis Obispo County.....	.75
Map No. 20—Long Beach Oil Field.....	1.00
Map No. 21—Portion of District 4, Showing Boundaries of Oil Fields, Kern and Kings counties.....	.75
Map No. 22—Portion of District 3, Showing Oil Fields, Santa Barbara County.....	.75
Map No. 23—Portion of District 2, Showing Boundaries of Oil Fields, Ventura County.....	.75
Map No. 24—Portion of District 1, Showing Boundaries of Oil Fields, Los Angeles and Orange counties.....	.75
Map No. 26—Huntington Beach Oil Field.....	.75
Map No. 27—Santa Fe Springs Oil Field.....	.75
Map No. 28—Torrance, Los Angeles County.....	.75
Map No. 29—Dominguez, Los Angeles County.....	1.00
Map No. 30—Rosecrans, Los Angeles County.....	1.00
Map No. 31—Inglewood, Los Angeles County.....	.75

DETERMINATION OF MINERAL SAMPLES.

Samples (limited to three at one time) of any mineral found in the state may be sent to the Bureau for identification, and the same will be classified free of charge. No samples will be determined if received from points outside the state. It must be understood that no assays, or quantitative determinations will be made. Samples should be in lump form if possible, and marked plainly with name of sender on outside of package, etc. No samples will be received unless delivery charges are prepaid. A letter should accompany sample, giving locality where mineral was found and the nature of the information desired.

THE STATE MINING BUREAU
CORDIALLY INVITES YOU TO VISIT
ITS VARIOUS DEPARTMENTS MAINTAINED
FOR THE PURPOSE OF FURTHERING
THE DEVELOPMENT OF THE
MINERAL RESOURCES OF CALI-
FORNIA

At the service of the public are the scientific reference library and reading room, the general information bureau, the laboratory for the free determination of mineral samples found in the state, and the largest museum of mineral specimens on the Pacific Coast. The time and attention of the state mineralogist, as well as that of his technical staff, are also at your disposal.

Office hours: 9 a.m. to 5 p.m. daily
Saturday, 9 a.m. to 12 m.

Lloyd L. Root,
State Mineralogist.

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Branch Offices: New Orpheum Building, Los Angeles; Chamber of Commerce Building (mail address, P. O. Box 1208), Sacramento; Bank of Italy Building, Bakersfield; Taft, Coalinga, Santa Maria, and Santa Paula.

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NOTE.—A detailed report of the activities of the Department of Petroleum and Gas is issued monthly by the State Mining Bureau, entitled 'Summary of Operations, California Oil Fields.'

CALIFORNIA STATE MINING BUREAU

FERRY BUILDING, SAN FRANCISCO

LLOYD L. ROOT

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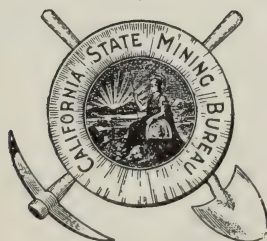
REPORT XXII OF THE STATE
MINERALOGIST

COVERING

MINING IN CALIFORNIA

AND THE

ACTIVITIES OF THE STATE MINING BUREAU



CALIFORNIA STATE PRINTING OFFICE
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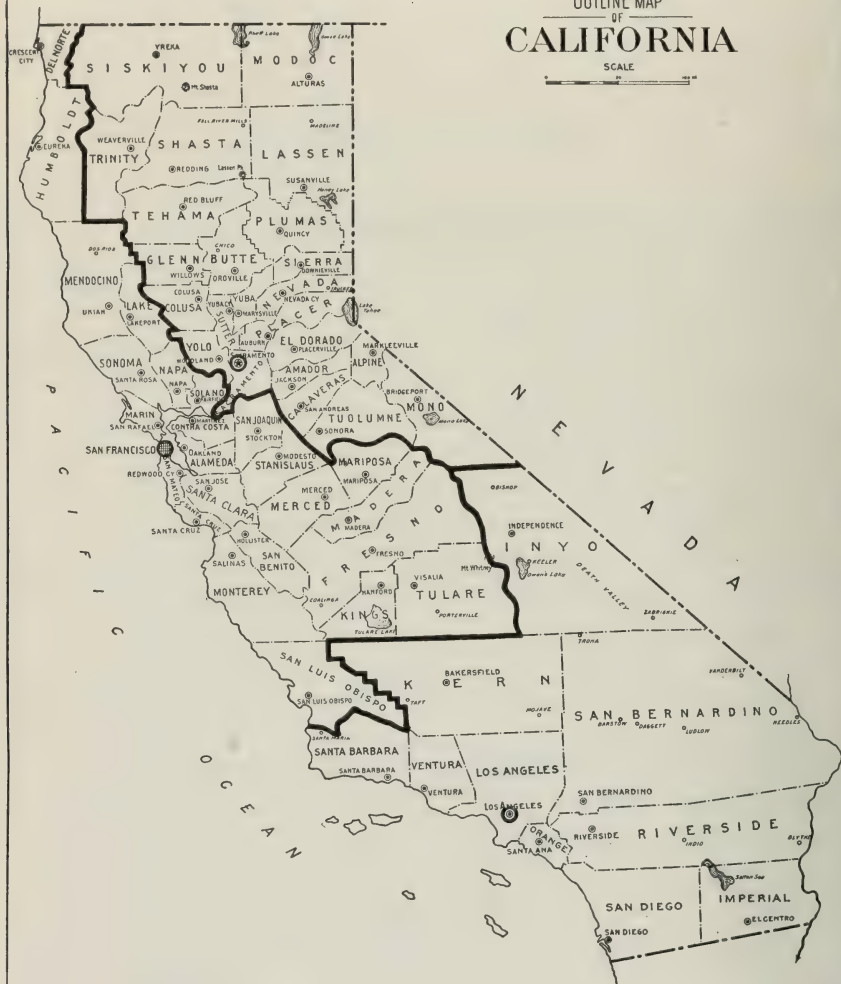
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CALIFORNIA STATE MINING BUREAU
LLOYD L. ROOT
STATE MINERALOGIST

OUTLINE MAP
OF
CALIFORNIA

SCALE
0 10 20 30 Miles



- **LEGEND** -
 — Mining Division Boundaries.
 ○ Mining Division Offices.

MEXICO

PREFACE.

The State Mining Bureau is maintained for the purpose of assisting in all possible ways in the development of California's mineral resources.

As one means of offering tangible service to the mining public, the State Mineralogist for many years has issued an annual or a biennial report reviewing in detail the mines and mineral deposits of the various counties.

The weak point in work of this character has been that the results of field investigations were so long in preparation that they had lost much of their usefulness by the time they finally appeared in print.

As a progressive step in advancing the interests of the mineral industry, publication of the Annual Report of the State Mineralogist in the form of monthly chapters was begun in January, 1922, and continued until March, 1923.

Owing to a lack of funds for printing, quarterly publication was begun in September, 1923.

For the same reason, beginning with the January, 1924, issue, it has been necessary to charge a subscription price of \$1 per calendar year, payable in advance; single copies, 25 cents apiece. 'Mining in California' will continue to be sent without charge to our exchange list, including schools and public libraries, as are also other publications of the State Mining Bureau.

Pages are numbered consecutively throughout the year and an index to the complete reports is included annually in the closing number.

Such a publication admits of several improvements over the old method of procedure. Each issue contains a report of the current development and mining activities of the state, prepared by the district mining engineers. Special articles dealing with various phases of mining and allied subjects by members of the staff and other contributors are included. Mineral production reports formerly issued only as an annual statistical bulletin are published herein as soon as returns from producers are compiled. The executive activities, and those of the laboratory, museum, library, employment service and other features with which the public has had too little acquaintance also are reported.

While current activities of all descriptions will be covered in these chapters, the Bureau will not discontinue its practice of issuing from time to time technical reports on special subjects. A list of such reports now available is appended hereto, and the names of new bulletins will be added in the future as they are completed.

The chapters will be subject to revision, correction and improvement. Constructive suggestions from the mining public will be gladly received, and are invited.

The one aim of the Mining Bureau is to increase its usefulness and to stimulate the intelligent development of the wonderful, latent resources of the State of California.



Canyon of Pit River, fifteen miles northeast of Cassel, Shasta County.
Photo by H. Williams, Cassel.



Diatomite deposit at Warner Bridge on Pit River, near Burney.

DISTRICT REPORTS OF MINING ENGINEERS.

In 1919-1920 the Mining Department was organized into four main geographical divisions, with the field work delegated to a mining engineer in each district working out from field offices that were established in Redding, Auburn, San Francisco and Los Angeles, respectively.

This move brought the Bureau into closer personal contact with operators, and it has many advantages over former methods of conducting field work.

To continue this system most effectively with the limited funds available for the present biennium, the Redding and Auburn field offices were consolidated and moved to Sacramento on June 1, 1923.

The boundaries of each district were adjusted and the counties now included in each of the three divisions, and the locations of the branch offices, are shown on the accompanying outline map of the state. (Frontispiece.)

Reports of mining activities and development in each division, prepared by the district engineer, will continue to appear under the proper field division heading.

Although the petroleum industry is but little affiliated with other branches of mining, oil and gas are among the most valuable mineral products of California, and a report by the State Oil and Gas Supervisor on the current development and general conditions in the state's oil fields is included under this heading.

New County Reports.

The series of separate reports on the mines and mineral resources of the different counties, that together comprise the State Mineralogist's Reports XIV to XVII, inclusive, in the case of many of the counties have become exhausted. Those still in stock are in need of revision. It has been thought advisable, therefore, beginning with the January, 1925, issue of 'Mining in California,' to make the district engineers' reports in the form of a complete general report on the mines and mineral resources in one or more of the counties in each district.

This program will be followed as near as possible in succeeding numbers of the quarterly until each county in the state has been covered.

SACRAMENTO FIELD DIVISION.

C. A. LOGAN, Mining Engineer.

SHASTA COUNTY.

Geography.

This county lies at the northern end of the Great Central Valley of California. Redding, the county seat, is 175 miles north of Sacramento, and is the principal railroad and supply point for Shasta and Trinity counties. The Pacific Highway traverses the valley, connecting Oregon and California cities. It is an excellent concrete road to a point north of Redding, and from there to the state line is now being completed on a series of easy grades and under specifications that make it one of the most attractive scenic routes in the state. From this highway



Effect of the eruption of Lassen Peak, May 19, 1915, on the head of Hat Creek, Shasta County, California. (No. 1 in series of three.) This view endured for a period of less than three days. Photo by E. F. Loomis. Furnished by courtesy of M. E. Dittmar.

good branch roads lead to all the mining districts of the county, and due to the generally mild climate are passable all the year for autos. The Oregon line of the Southern Pacific Railroad gives the county rail connection with California points on the west and south and Oregon and other states to the north and northeast, following the canyon of Sacramento River north of Redding.

Shasta County has an area of 3858 square miles and in 1920 had a population of 13,311, most of whom live in the valley regions contiguous to Sacramento River. The river leaves its mountainous canyon near Redding and south of there flows through an open and rolling country devoted to farming. The mineral deposits are confined to the western half of the county. Most of the eastern half is covered by volcanic rocks. To the west and northwest ranges of the Klamath Mountains separate Shasta from Trinity and Siskiyou counties. Lassen, Modoc and eastern Siskiyou counties on the north and east, as well as eastern Shasta, are covered by comparatively recent volcanic flows and the elevation of this lava field rises steadily as one travels eastward, until the high mountain peaks are reached.

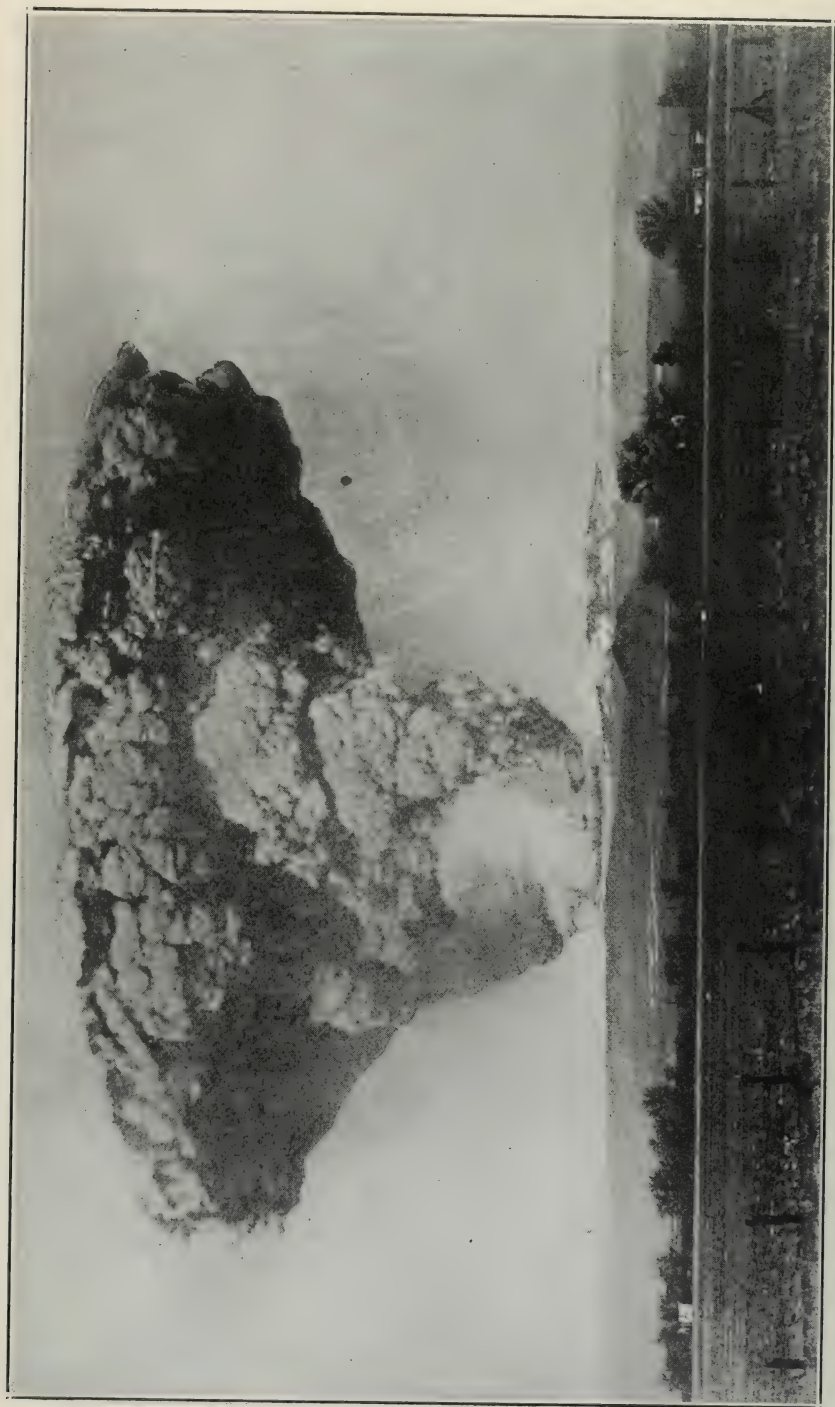
Lassen Peak, the only active volcano in the continental United States, is in the southeastern corner of Shasta County. This volcano became active May 30, 1914, with a series of steam explosions which threw stones over an area of a mile square and ejected volcanic ash which was carried quite a distance by the wind. On June 14 of the same year, two new craters were opened on the mountain a mile from the main crater. This was accompanied by a shower of ash and stones, and the emission of much smoke. Many times since then, vapor has been observed issuing from the mountain, especially during the spring and early summer, when the snow is melting. The last activity noted was during the past month (March, 1926). Lassen National Park has been set aside by the government. It embraces Lassen Peak and the nearby area, in which are still to be seen numerous signs of volcanic activity, such as hot springs, boiling mud pools and recent small sulphur deposits. The last real lava flow in the United States came from Lassen Peak in 1915, according to M. E. Dittmar.¹ The last previous flow, from the Cinder Cone, on the Lassen County line, is placed by Dittmar 130 years ago but Diller² placed it 200 years ago.

Mineral Resources.

Shasta County is distinguished by the variety and complexity of its geologic formations and the great diversity of its mineral resources. The principal free-gold quartz mines are found in the Bragdon (Carboniferous) slates which extend for many miles along the Trinity-Shasta counties line from Deadwood through French Gulch and northward. While the gold production has been notable, exceeding a total of \$30,000,000 since 1880, this branch of the industry has been quiet and production has fallen off since 1916. The quartz mines in the Shasta, Whiskeytown, Old Diggins and adjacent districts, between the railroad and the western slate belt, carry mostly base, and often low-grade ores, with one-half or more of the gold in the sulphides, so that smelting is required. These mines were advantageously operated while the copper smelters were in commission, as the quartz was in

¹ Secretary, Lassen Volcanic National Park Association.

² Diller, J. S., Geologist, U. S. Geological Survey.



No. 2. The final great cataclysmic eruption of Lassen Peak, May 22, 1915. Taken from point on the Southern Pacific railroad about 40 miles to the west, Shasta County, California. Photo by E. F. Loomis, Viola. Furnished by courtesy of M. E. Dittmar.

demand for flux. Harrison Gulch district, in the southwestern corner of the county, had one notable quartz mine, the Midas, which produced very rich free-milling ore. This property is expected to be reopened soon.

Placer mining production in recent years has been principally from two gold dredgers, one on Cottonwood Creek along the southern county line, and one on Clear Creek southwest of Redding.

Silver has been produced as a by-product of copper and gold mining, but the county also had a district of distinctly silver-bearing ores, $2\frac{1}{2}$ to 4 miles northwest of Igo. None of the mines in this district are active.

The county has been chiefly known as a producer of copper. Production of this metal began in 1896, and until 1920 Shasta led all the other counties in this item, which in value often exceeded the gold output of the important quartz mining counties to the south. While the peak of copper production appears to have been passed, and the smelters are idle or being dismantled, there are still important copper orebodies unworked. With increased depth in some of the copper mines it was found that the amount of zinc in the ores was increasing to the point where zinc sulphide predominated and copper became subordinate. Attention is now being given to the zinc ores, which are mined at Ingot and Bully Hill and concentrated at the latter place.

Pyrite has also come to be an important product, the Hornet Mine steadily producing a larger tonnage than any other pyrite mine in the state. From 1894 to 1918, Shasta County was an important producer of chromite, having at the Little Castle Creek Mine the largest body of this ore yet found in the west.

The iron ore resources are notable, and the deposit near Heroult continued the production of good grade ore which was used at Pacific coast plants until the mine was closed about a year ago. Here the Noble Electric Steel Company worked out successful methods for the electric smelting of iron and the production of ferro-silicon and ferromanganese was carried on during the late war. Cadmium, platinum, molybdenum and lead have also been produced in small quantities from the county.

Among the nonmetallic minerals, the most important are the immense beds of limestone, exceeding in quantity those of any other county in the state. These deposits are in large part near enough to the railroad to be cheaply available for cement, with suitable shale beds nearby. Development of the mineral to date has been on a small scale only, for use at smelters chiefly, and no kilns are now in operation.

Of great interest as a possible future source of fuel, are the extensive beds of black lignite found in the central part of the county. These beds are being prospected, and the lignite is known to occur for a length of 12 miles or more. Proper methods of treatment may lead to the successful production of powdered fuel.

Large and valuable deposits of asbestos, brick clay, barytes, miscellaneous stone, talc, and diatomaceous earth are found and most of these are being prospected at present. Tuff, sandstone and other stones suitable for building occur. The diatomaceous earth deposit along Pit River at and below the junction of Hat Creek in the northeastern part of the county is an example of the only important class of deposit within the great sheet of later lava.

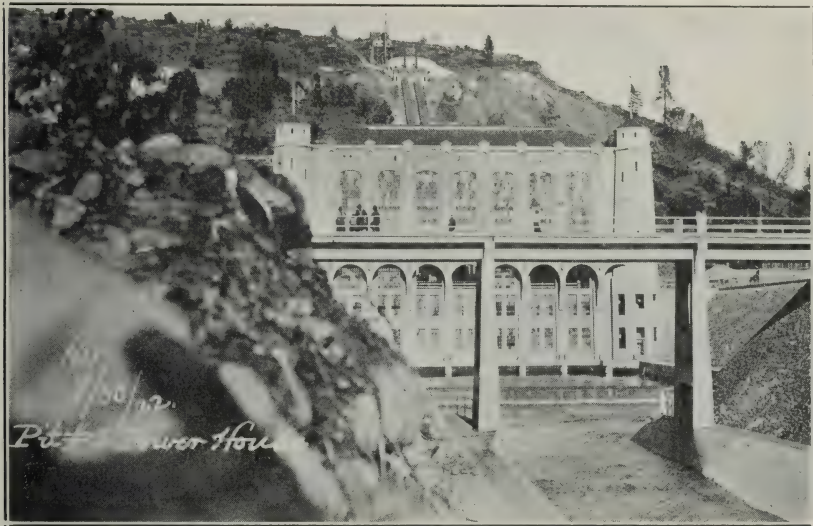


No. 3. The devastated area at the head of Hat and Lost creeks after the final great eruption of Lassen Peak, and as it now appears. From same point of view as shown in No. 1. Note the stumps of trees (seen on right and left lower slopes) whose tops were sheared off by the terrific force of the final volcanic blast. Photo by B. F. Loomis, Viola. Furnished by courtesy of M. E. Dittmar.

Power.

The vast lava beds of northeastern California form a remarkable underground reservoir from which Pit River draws a nearly uniform volume of water throughout the year, with less seasonal variation of flow than in any other important stream in the state. The river also has sufficient grade, and numerous sites in its canyon are favorable for the building of high dams, so that it is peculiarly attractive as a source of hydroelectric power. The Pit River development program of Pacific Gas and Electric Company, which is partly completed, is one of the most important projects of the kind ever undertaken, as regards magnitude and cost, the length of transmission lines and voltage employed.

Two power houses, called Pit 1 and Pit 3 (see photos and map) are in commission, the construction work for a third is under way and



Pit No. 1 Power House of Pacific Gas and Electric Company on Pit River, Shasta County. Photo by H. Williams, Cassel.

several others are planned. High-tension steel tower lines transmit electricity under a potential of 220,000 volts from each of these generating stations to a newly erected station near Vacaville, where the voltage is stepped down and electricity is distributed to many cities around San Francisco bay as well as farther inland.

Electric power lines serve all the mining districts of the county, and large consumers enjoy low rates.

Timber.

Both the eastern and western parts of the county are covered by good sized timber, as is also part of the upper canyon of the Sacramento, although the last named section has been largely cut over because of its accessibility. The lowland country near the river, and the copper mining districts, support only scrub growth. Northeastern Shasta

County, from the vicinity of Round Mountain northeastward, and contiguous to the Alturas highway, has one of the finest stands of virgin timber in the state.

Transportation.

The large copper mines operated their own tramways and railroads to connect with the Southern Pacific main line. Sacramento Valley and Eastern Railway from Pit on the main line to Winthrop serves the Heroult and Copper City districts as well as the mines at Bully Hill. From Sisson on the main line the McCloud River Railroad runs 36 miles east to Bartle. From this point Pacific Gas and Electric Company's Pit River railroad runs about 30 miles to the site of their power developments on Pit River giving an outlet for the immense diatomaceous earth deposits in that section.



Pit No. 3 dam from upstream. On Pit River near Burney, Shasta County.
Photo by H. Williams, Cassel.

ASBESTOS.

Chrysotile and amphibole asbestos of good quality have been known for years and have been described in past reports of this bureau, dealing with Shasta County. The deposits are from three to seven miles north and northwest of Sims in Townships 37 and 38 North, Ranges 4 and 5 West, in the northwestern part of the county. Development has been slow and only a little production has been recorded.

Anaconda Prospect is in Sec. 6, T. 37 N., R. 4 W., four miles north of Sims.

D. E. Miles Prospect is in Sec. 36, T. 38 N., R. 5 W., five miles north of Sims.

Stock Asbestos Mines (formerly Stock & Stevens) are in Secs. 1, 2, 3, and 4, T. 37 N., R. 5 W., and Secs. 33 and 34, T. 38 N., R. 5 W., from three to six miles northwest of Sims and at an elevation of 3500 to 6300 feet. Mears Creek flows through the claims. Owner,

SHASTA COUNTY, 1880-1925.

Year	Brick		Chromite		Copper		Gold, value	Lime		Limestone		Mineral water		Pyrites		Silver, value	Miscellaneous and unapportioned			
	M.	Value	Tons	Value	Pounds	Value		Barrels	Value	Tons	Value	Gallons	Value	Tons	Value		Amount	Value	Substance	
1880							\$140,455									\$117,907				
1881							350,000									85,000				
1882							300,000									80,000				
1883							210,000									20,000				
1884							320,000									30,000				
1885							417,004									9,223				
1886							699,508									10,647				
1887							627,681									40,204				
1888							600,000									50,000				
1889							415,631									5,396				
1890							420,530									7,279				
1891							554,063									7,432				
1892							574,833									7,977				
1893							500,407									8,577				
1894			1,200	\$16,800			617,436					150,000	\$75,000			5,032	200 tons	\$1,500	Iron ore.	
1895			90	1,120			718,696									28,417				
1896	300	\$1,500			1,847,087	\$184,708	599,209	2,310	\$2,541							24,233		1,400	Stone industry.	
1897	1,200	7,200			13,592,610	1,535,966	569,071	2,100	2,100	9,000	\$13,500					96,869				
1898	1,200	7,200			21,442,000	2,465,830	860,180	2,500	3,750			3,000	2,000			171,768				
1899	2,000	14,000			21,835,863	3,565,023	873,719	8,000	10,000	250	375	5,000	1,850			196,213	100 sq'rs	800	Slate.	
1900	2,000	12,000	140	1,400	25,736,473	4,166,735	733,407	17,850	17,850	1,150	1,150	9,640	5,784			635,640		375	Stone industry.	
1901	3,000	12,000	130	1,950	30,990,781	4,881,048	927,975	21,600	12,960			26,295	7,644			891,994		2,000	Stone industry.	
1902	2,450	12,250	315	4,275	21,515,887	2,496,731	878,706	18,500	12,500	3,500	3,600	26,295	7,645	3,202	\$7,005	306,887				
1903	3,500	17,500	150	2,250	16,453,409	2,171,497	771,242	27,000	10,800	5,400	5,400	40,000	12,000	2,500	5,500	203,991		1,500	Stone industry.	
1904	3,000	15,000	98	1,470	26,438,145	3,439,974	1,031,429	18,000	10,500							399,660		47,723	Unapportioned, 1900-1909.	
1905	3,500	14,000	20	300	10,830,865	1,688,614	684,952	10,700	8,000	3,600	3,600	80,000	12,000			167,548				
1906	4,400	22,000	80	1,200	22,477,304	4,338,121	819,144	12,860	8,040	27,000	32,960			32,689	89,895	434,483				
1907	4,500	33,000	260	5,200	27,844,364	5,568,873	791,997	29,222	31,900	30,761	30,761			65,788	197,364	370,211	400 tons	400	Iron ore.	
1908	2,000	12,000	280	5,600	34,878,677	4,642,976	1,131,832	11,818	9,100	80,000	80,000	100,000	20,000	93,677	539,553	517,596		25,000	Stone industry.	
1909	3,500	23,500	205	3,517	58,665,447	7,581,115	1,600,489	8,650	8,000	129,560	134,595	100,000	20,000	449,762	1,349,286	735,460	108 tons	174	Iron ore.	
1910	2,425	17,548	680	9,155	44,947,950	5,725,469	1,533,728	16,616	14,114	117,109	117,083	40,000	10,000	31,683	126,692	648,905	579 tons	900	Stone industry.	
1911	2,825	20,094	875	13,697	29,539,913	3,692,489	1,059,881	13,271	10,164	67,924	65,253	25,000	6,250	47,885	151,602	386,991	1,859 lbs.	83	Lead.	
1912	1,697	10,195	1,000	8,000	25,249,892	4,166,232	986,803	6,529	3,548	58,022	45,575	23,225	5,646	62,605	174,402	425,382	881 lbs.	40	Lead.	
1913	360	4,330	280	2,800	27,686,436	4,291,708	1,208,870	8,595	7,030	41,346	35,616	30,000	6,850	72,071	194,409	448,031	47 tons	1,175	Asbestos.	
1914	1,594	10,223	867	4,884	25,122,766	3,341,328	1,101,202	8,657	5,163	36,997	30,026	30,000	6,850	69,438	195,362	346,706	19,070 lbs.	839	Lead.	
1915	1,836	11,550	1,757	17,570	30,828,917	5,395,060	1,120,848	"		44,953	40,945	12,000	1,800	"		459,566	1,436 tons	10,686	Other minerals.	
1916	"		12,425	181,225	39,437,196	9,701,550	936,885	"		"		"		"		1,115,471	21,565 lbs.	5,128	Iron ore.	
1917	"		3,116	68,479	28,009,990	7,646,727	775,125	"		"		"		"		520,703	841	125	Lead.	
1918	"		1,423	70,214	25,294,590	6,247,764	543,509			45,671	72,410			"		420,410	180,936 lbs.	8,504	Miscellaneous stone.	
1919	"				8,673,342	1,613,242	378,283	"		"		"		138,046	497,398	165,802	1,418	1,418	Lead.	
1920	"				810,843	149,195	312,901							135,399	475,330	36,563	8,378,401 lbs.	1,038,922	Zinc.	
1921					437,593	56,449	267,681	"		"				"		5,581	253,950	478,560 lbs.	33,021	Iron ore, pyrites, lime.
1922					1,827,875	246,763	393,034							"		26,901	33,021		57,303	Lead.
1923					3,437,963	505,381	359,487							"		47,706	57,303		723,910	Lime and limestone.
1924					21,109,958	2,765,405	346,622			28,097	36,480			"		343,402	0,494,800 lbs.	1,270,963	33,021	Zinc.
Totals	47,287	\$277,090	25,391	\$421,106	646,964,136	\$104,381,973	\$31,064,515	244,778	\$188,060	686,669	\$676,919	700,455	\$201,319	1,205,645	\$4,003,798	\$11,063,764				

¹Dredge production included under Stanislaus County.

²See under 'Unapportioned'.

SHASTA COUNTY
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H. E. Stock, Humboldt Bank Building, San Francisco. The original holdings covered 1100 acres.

The country rock is principally serpentine, with later dikes of diorite and gneiss. Extensive outcrops of chrysotile-bearing rock, without overburden, occur and several sites for quarries have been selected and some work done on them. A great deal of actinolite is also said to be found, as well as other forms of asbestos. Disagreements among the owners hindered development for many years.

Bibl: Cal. State Min. Bur. R. XIV, pp. 752-755.

BARIUM.

The ore 'barytes' is essentially barium sulphate (barite) usually containing from 5% to 15% of other minerals. Silica, calcite, iron oxide, copper and iron sulphides and small amounts of carbon are the commonest of these. Any mineral which will discolor the barite when ground is objectionable as the mineral is used most extensively as an inert filler in paints and as a constituent of lithopone where a pure white is desired. Calcite is also objectionable, even when white. The sulphides of metallic minerals are hard to separate mechanically from barite because of the nearly equal specific gravities. Numerous other uses for barite depend on its insolubility (and consequent inertness), high specific gravity, and chemical characteristics of many compounds prepared from it. It is used as an inert filler in rubber, paper, oilcloth and linoleum. Barium compounds made from it are used in pottery, in making rubber, battery plates and in several chemicals. For some of these uses the color is not a critical factor.

Many barytes deposits of California are sufficiently 'off-color' to require chemical treatment, although carrying only a small percentage of impurities. Such crude ore commands a lower price than 'white-grinding' ore. Witherite (barium carbonate) is much rarer in California than the sulphate. One plant has been operated at intervals during recent years in Oakland, treating California ores for use in lithopone. It has changed hands several times, and is expected to reopen soon after several years idleness. Another has lately been built at Modesto.

Barite occurs as a gangue mineral in the copper mines of Shasta County, and a few deposits have been noted in different parts of the county.

H. C. Austin operated a quarry on a deposit in Sec. 29, T. 34 N., R. 3 W., near Copper City several years ago and shipped ore to Oakland. This has been idle the past two years, and is said to be worked out.

Barite No. 1 and No. 2 claims. Mike Malone, Platina P. O., owner. These claims are reported to be on a prospect of witherite, so far found as float. They are on Beegum Creek near Platina, which is 41 miles by road from either Red Bluff or Redding.

Exposed Treasure No. 1 and No. 2 claims are in Sec. 33, T. 36 N., R. 1 W. Owners, C. A. Packwood and Alonzo Luce, 333 North Butte Street, Willows. The claims are 12 miles north of Montgomery Creek, which is 44 miles by road from Redding. A road passes within less than one-half mile of claims.

Packwood states that barytes outcrops at intervals for 3000 feet, with a width of four feet. Only assessment work, consisting of a few holes, has been done. A depth of 22 feet has been reached. Samples shown are dark gray, but apparently fair grade.

Loftus Barytes Prospect. Owners, Loftus and Sons, Castella. Lessee, Chemical & Pigments Company. It is in Sec. 18, T. 38 N., R. 3 W., on the headwaters of Tom Neal Creek, seven miles by trail from Castella and at an elevation of 5000 feet.

'Off-color' barytes is said to outcrop at intervals for one-half mile. H. C. Austin did some prospecting on the claims in 1923. Lately an Oakland firm has taken a lease and option and is prospecting and developing the ore. Two egg-shaped deposits are said to have been found, in limestone. Nearly three miles of tramway, with a difference in elevation of 3000 feet between terminals, would be required to deliver ore to railroad. Work so far has been shallow.

CADMIUM.

Cadmium occurs as greenockite in the copper-zinc ores of Shasta County.¹ Greenockite is rare, but found at times as a lemon yellow coating with resinous luster, on zincblende.

The only recorded production of cadmium from California was from the electrolytic zinc plant of the Mammoth Copper Company during 1917-18, where several thousand pounds of cadmium metal was produced. Cadmium sulphide is used for yellow paint pigment and coloring glass, and cadmium in making alloys of low-melting point and bronze wire. There is no production locally at present, although the zinc concentrate shipped abroad from Winthrop probably carries cadmium.

CHROMITE.

In the northwestern corner of Shasta County there is an area in which serpentine and basic igneous rocks more or less altered to serpentine occur abundantly. They are contained within the area mapped by Smith² as "Paleozoic metamorphics undifferentiated: including limestones, slates and associated igneous and metamorphic rocks of the Klamath Mountains," which extends from near Lamoine, northeasterly to and beyond Dunsmuir. Though this metamorphic area appears on both sides of the Sacramento River north of Gibson, no serpentine nor chromite have as yet been reported east of the river. From the northern end of this serpentine belt has come the second largest single lens of chromite thus far developed in the United States. From the Little Castle Creek mine on the creek of the same name near Dunsmuir, on the Shasta-Siskiyou County line, the records of the State Mining Bureau show that upwards of 15,000 tons of chromite were shipped from 1900 to the end of 1916. Much of the chromite in this district is massive and high grade, but some disseminated orebodies have been noted in at least one locality.

Other good sized orebodies, among the largest in the state, besides the Little Castle Creek deposit, were worked. These were on the Shot-

¹ Eakle, A. S., Cal. State Min. Bur. Bull. 91, p. 47.

² Smith, J. P., Geological map of California, accompanying The geologic formations of California: Cal. State Min. Bur. Bull. No. 72, p. 9, 1916

gun Creek claims of Noble Electric Steel Company near Sims, and the Forest Queen and Gray Eagle groups of claims.

These and numerous other properties were mentioned in our Bulletin 76, published in 1918. While Shasta County had been producing chromite for nearly 20 years previous to the world war for use at smelters, the principal production was during 1916, when under the stimulation of war demand and high prices, nearly one-half of the county's total production of 25,391 tons was made. Since the close of the war there has been little demand for chromite on the Pacific coast, and little production is recorded from this county since 1918. While the main orebody of the largest producer, the Little Castle Creek Mine, is worked out, other properties still contain ore.

Don Noble, Platina, reported the sale of two carloads, or about 100 tons ranging from 40% to 54% Cr_2O_3 , from the Beegum district in 1925.

Bibl: Cal. State Min. Bur. Bull. 76, pp. 181-88, 222.

CLAY.

Clay suitable for making common brick occurs abundantly in the county in the flood plain of Sacramento River south of Redding, and along numerous other streams more remote from the railroad. A brick plant was formerly operated at Anderson but has been idle for many years. A little clay found as gouge or selvage with the orebodies in the copper mines has been used for lining copper converters, particularly at Bully Hill.

No clay products have been made in the county since the Anderson brick plant quit operation. This property had its own clay bed nearby, and supplied the northern part of the valley. The large brick kiln with a capacity of 40,000 brick in 7 hours and with a stack 120 feet high, still stands and is outwardly in good condition but there is no machinery. This property contained a clay deposit 15 feet thick.

Other clay deposits near transportation are:

Block 29, Redding Grant, $1\frac{1}{4}$ miles south of Redding. Clay bed six feet thick. A brick kiln was operated here many years ago. Idle for a long time.

Sec. 34, T. 34 N., R. 5 W. A deposit of fire-clay was formerly operated here by Holt & Gregg. Idle.

Redding Brick & Tile Company formerly operated a deposit on 40 acres in Sec. 19, T. 31 N., R. 5 W. and made brick in a small kiln at Redding. Idle for many years.

Redding Homestead Deposit is on the Sacramento River east of Cottonwood. Deposit is a mile long by one-fourth mile wide and contains 30 feet of clay, covered by 15 feet of sand and gravel. Idle and undeveloped.

Southern Pacific Company owns an undeveloped clay deposit in Sec. 19, T. 32 N., R. 4 W.

Bibl: Cal. State Min. Bur. R. XIV, p. 756; Bull. 38, p. 257.

COAL.

History.

That the lignite prospects of central Shasta County were known in 1863, and were being prospected as early as 1874, is shown by W. A. Goodyear's mention of the district in the Seventh Report of the State Mineralogist, pages 149 and 150. He described work that had been done apparently near the recent work on the Luce property, and gave a section of the coal bed. In 1876, when he again visited the place, work had been abandoned. He mentioned another tunnel, which had been driven nearby for a length of 400 to 500 feet. He also alluded to other coal outcrops which he noticed in Secs. 3, 7, 8 and 21, T. 33 N., R. 1 W., in Sec. 12, T. 33 N., R. 2 W., and elsewhere, none of which had been found up to that time to contain marketable coal.

In the same volume, Adolph H. Weber briefly described coal prospects in the SE $\frac{1}{4}$ of Sec. 28, T. 33 N., R. 1 W., in the SE $\frac{1}{4}$ of Sec. 29 adjoining, and in Secs. 1, 2, 3, 4 and 5, T. 33 N., R. 1 W. and in Secs. 32, 33 and 34, T. 34 N., R. 1 W. In 1876, a short tunnel was run on a coal prospect in Sec. 12, T. 33 N., R. 2 W. At about the same time, or during the ten years next following, coal prospects were found and some of them slightly prospected in the following places:

E $\frac{1}{2}$ of Sec. 11, and N $\frac{1}{2}$ of Sec. 14, T. 35 N., R. 1 W.

NE $\frac{1}{4}$ of NE $\frac{1}{4}$ of Sec. 32 and NW $\frac{1}{4}$ of Sec. 33, T. 33 N., R. 1 W.

T. 37 N., R. 1 E., on Nelson Creek.

Sec. 24, T. 37 N., R. 1 W., on Kosk Creek, also near the head of the same creek.

None of these, so far as known, ever yielded coal in commercial quantities, and all of the prospects had lain idle for a long time when work was begun by P. B. Cross and associates on the Luce property in 1923.

Geology.

In central Shasta County the sedimentary rocks of the Chico (Cretaceous) and Ione (Tertiary) are overlain by the later Tuscan Tuff (late Tertiary) and still later basalt and cobbles. The lignite occurs mostly in the Ione, which is only about 50 feet thick in places but is much thicker elsewhere, reaching a thickness of 1000 feet on Kosk Creek. It is a series of rather soft, slightly consolidated sandstone, shale and conglomerate beds. The overlying basalt and cobble layer is about 30 feet thick in many places. At the Luce coal workings, where the beds appear to be undisturbed, the coal seams dip north and east at an angle of seven degrees. The roof of coal is soft sandstone and shale and the floor is shale. Diller in the Redding Folio of the U. S. Geological Survey describes the Ione formation and alludes to the difficulty of determining whether some of the beds lacking distinctive fossils are Ione or Cretaceous. In the Lassen Peak Folio, he places some of the coal seams of this region in the Chico (Cretaceous). As far as could be learned from G. H. Rees, superintendent in local charge of recent work, the present operators have had no determinations of fossils made, and are uncertain as to the age of formations in which they are working. Since the Ione beds lie so flat, and are comparatively thin, it is probable that the inclined shafts being sunk, will soon pass from the Ione into the Chico, if they have not already done so, as these shafts

have a dip of about 45° . During the time when the Ione formation was deposited, an arm of the sea filled the Sacramento Valley, extending northeast through the region where the lignite occurs, but the water in this region is supposed to have been relatively fresh. Periods favorable to the deposition of lignitic material appear to have been interrupted by shorter periods when mud and sand were deposited, resulting in a series of beds of lignite alternating with thin partings of shale, each too narrow to be sorted out, but in the aggregate sufficient to lower the quality of the coal by the introduction of waste.

The lignite is mostly black and lustrous when first mined, and, in physical appearance, seems distinctly older than the brown lignite of the typical Ione beds, near the town of Ione, Amador County. While the Ione lignite often shows woody structure and even the bark of trees, and cracks and crumbles in a short time when exposed and dried, the best seams of lignite near Oak Run do not show these characteristics so distinctly, although it probably would not stand transportation well. In chemical analysis, there is little difference between them, both being low in fixed carbon and high in volatile matter, and the ash content of the Ione lignite is slightly lower if published analyses are accurate; but it carries more water than the Oak Run lignite.

Some of the prospecting work lately done has shown the coal beds considerably faulted. This faulting is probably due to earth movements connected with late activity of Lassen Peak and neighboring volcanic cones. The disturbed area is in the southern part of the district, in Secs. 3, 4, and 9, T. 32 N., R. 1 W., and Secs. 33 and 34, T. 33 N., R. 1 W.

Working Conditions, Transportation and Markets.

The deposits lie at elevations ranging from 1500 to 2000 feet. There is little snowfall, and operating conditions are good. Electric power is available and in use at some of the prospects. Timber is scarce nearby but available a little higher in the mountains. Palo Cedro, the nearest railroad point, is 15 to 20 miles from the prospects. The aerial tram from the Afterthought Mine to Winthrop, where coal could be loaded on railroad cars, is only a few miles from the Barnes and Dakin prospects. Roads are good except in places where they traverse the cobble-strewn areas of basalt. Grades are easy and in favor of traffic from the prospects toward the railroad. There is only a small and scattered population in the district or east of it and the only possible chance for a railroad would be one at some future date to exploit the large timber holdings to the east and northeast.

The lignite offers a cheap source of fuel for local use, but the present population of this section of the state is small. Sacramento, the nearest city of any size, is nearly 200 miles distant and has a population of about 100,000. The population of the Sacramento Valley north of Sacramento County was about 115,000 in 1920, and at least half of this, as well as the city of Sacramento, is so situated that it could be served more cheaply from the Amador County mines, should this type of fuel ever come into general use, although neither field has yet developed a coal that will stand shipment well without breaking up. It is probable that the population of the Sacramento Valley will increase immensely in the next few decades. It is also probable that the price of crude oil, locally at least, will increase to such an extent that it will soon be

desirable to use some other source for the manufacture of gas. California lignite generally is high in volatile matter and it would be acceptable for such use. In this connection, it is interesting to note that Pacific Gas and Electric Company is now installing at their Marysville gas plant a new type of generator for making gas from coal, to work side by side with a generator using oil, in order to compare the relative costs of making gas by the two methods on a working scale. Tests of the Amador County lignite have shown it to yield a surprisingly high percentage of oil, under destructive distillation, besides a notable amount of ammonium sulphate. Powdered coal is also being adopted for fuel use, and would be of possibly great value for such a purpose as the manufacture of Portland cement which is sure to be undertaken at some future date in Shasta County where limestone occurs so abundantly. The Trent process or some similar method for the beneficiation of such coal, would, no doubt, reduce the waste and ash content of the Shasta lignite sufficiently to make it a very valuable fuel.

Recent Prospecting.

In 1923, Cross and Stevens began taking leases with options on land showing coal prospects in eastern Shasta County, and started work at the Lon Luce property with a few men. From time to time additional parcels of land were taken under royalty leases or options to purchase, until at present perhaps 15,000 acres are controlled extending from the vicinity of Clover Creek to Round Mountain. Prospecting operations have been carried on under the trusteeship of A. F. Hockenbeamer. John McNab and A. P. Cross of San Francisco. Late in May, 1926, these men incorporated as Mt. Shasta Coal Company. Nineteen men are employed under contract at three prospects (April, 1926). Griffith H. Rees, Lorenz Hotel, Redding, is in charge locally as superintendent. Results obtained so far at the principal openings are described below.

Barnes Prospect is on the Oscar Barnes ranch in SE $\frac{1}{4}$ of SE $\frac{1}{4}$ of Sec. 32, T. 34 N., R. 1 W., seven miles by road northeast of Ingot and at an elevation of 1740 feet.

An electric power-line, 5 $\frac{3}{4}$ miles long, has been built and a small hoist and compressor are in use. An incline, driven at the base of a lava-covered bluff, had reached a depth of about 200 feet on a 45° slope at time of visit, April 28. About one-half way down in this, two beds of coal occur on which 32 feet of drifting was done to take out a few tons for testing. The beds consist of alternating layers of coal, bone and clay. The coal seams vary in thickness from 2 to 22 inches with a total of about 67% of coal in the best section of 75 inches. The seams of bone and clay are mostly too narrow to permit sorting but according to G. H. Rees the total amount of such waste is sufficient to raise the ash content undesirably high.

After sampling the above beds, the incline was continued and at time of visit the sump showed black shale floor and grey clay shale roof. Rees believed this showed indications of nearness to another bed of coal.

The dip and strike of the coal beds on this property are about the same as at the Luce property, and the character of coal the same.

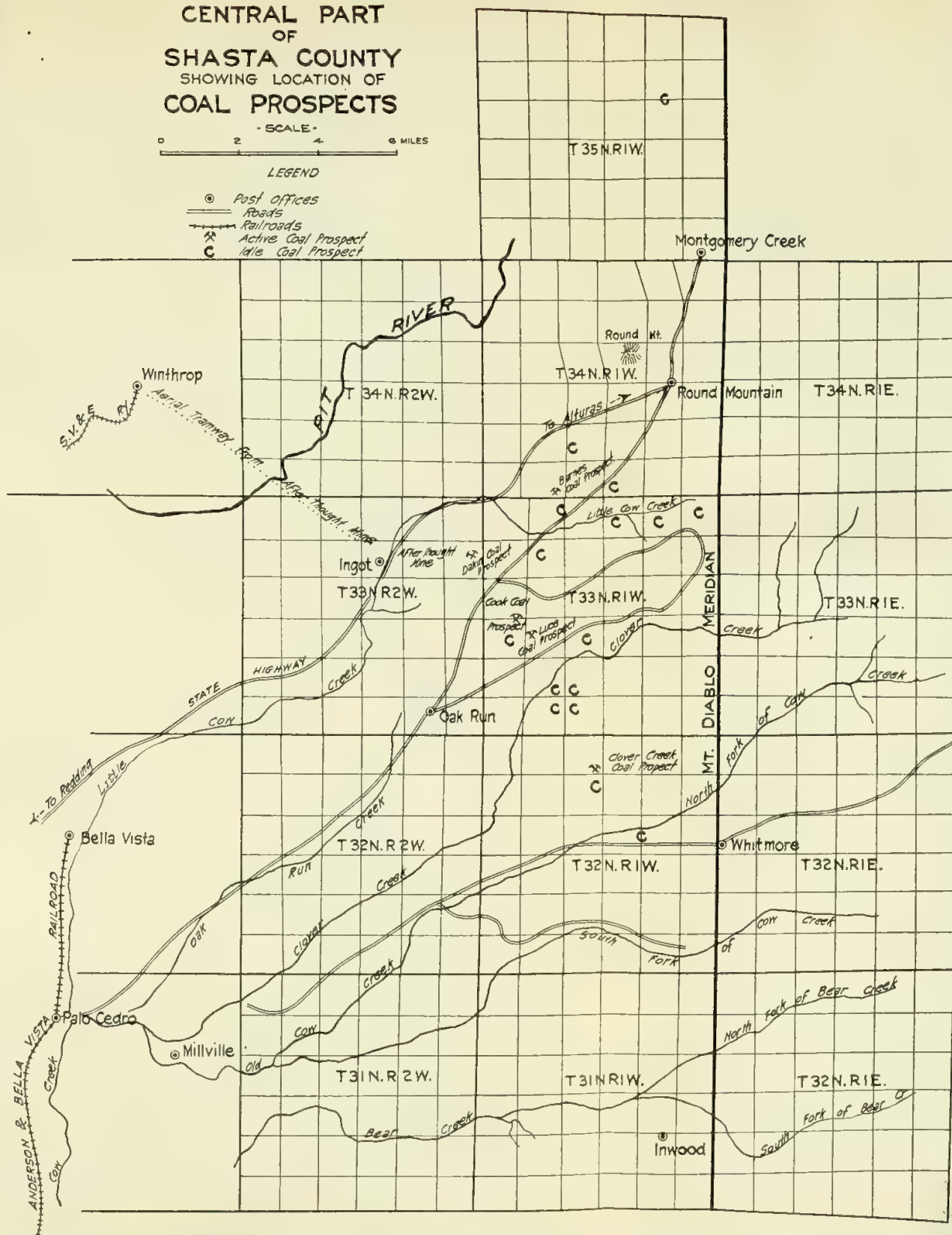
Clover Creek Prospect is on the N. B. Frisbie property in SE $\frac{1}{4}$ of SE $\frac{1}{4}$ of Sec. 4, T. 32 N., R. 1 W. Here the operators recently ran an adit 937 feet, N. 12° E., then sank an incline 164 feet on an angle of

CENTRAL PART OF SHASTA COUNTY SHOWING LOCATION OF COAL PROSPECTS

0 2 4 6 MILES
SCALE

LEGEND

- Post offices
- Roads
- Railroads
- ✕ Active Coal Prospect
- Idle Coal Prospect



45°. According to Rees, this work was in a zone of faulting about one mile wide and three miles long in parts of Sections 3, 4 and 9, T. 32 N., R. 1 W., and Sections 33 and 34, T. 33 N., R. 1 W., where the line of faulting struck east and the south side of the area appeared to have dropped. The formations were so badly broken that no promising prospect was found and the work here has been stopped.

Cook Prospect is about three-fourths of a mile northwest of the Luce property, in Sections 18 and 19, T. 33 N., R. 1 W. An adit 180 feet long struck coal with a steep dip.

Dakin Prospect is in the SE $\frac{1}{4}$ of NE $\frac{1}{4}$ of Sec. 12, T. 33 N., R. 2 W., at an elevation of 1900 to 2000 feet. The lignite was prospected between 1874 and 1900 and an adit 350 feet long was run. The deposit shows coal seams separated by thin layers of clay, the total thickness being 14 feet or more. The coal seams in the old workings vary from 6 inches to 2 $\frac{1}{2}$ feet in thickness and the greater part of the total width is coal. This property lay idle for about 25 years, without having made any commercial production. In 1924 the present operators began work and have a crew employed at present under contract. Results reported so far are similar to those described at the Barnes and Luce properties. Electric power is used and a small crew is employed sinking an incline.

Luce Prospect is in the SW $\frac{1}{4}$ of NW $\frac{1}{4}$ of Sec. 20, T. 33 N., R. 1 W. at an elevation of 1675 feet about three miles by road northeast of Oak Run P. O. In 1923, work by the present operators began not far from where the first prospectors operated many years ago. By the summer of 1924, a flat incline, following the coal bed, had reached a length of 320 feet, from which point the work had been turned north and a drift run nearly 150 feet farther but without gaining any additional backs as the drift was approaching the surface because of the slope of hill. This opening showed five to six feet in width composed mostly of lustrous black lignite, but there are numerous narrow seams and partings of bone and clay between the coal layers, enough to seriously affect the quality of coal by raising the amount of waste that can not be disposed of by sorting and which shows in the ash content. Work on this bed has been suspended since 1924. The coal dips northeast about seven degrees.

Subsequent work has been in an inclined winze on a dip of 45°, sunk from the inside of the flat incline. Electric power is used to operate a hoist in this winze, and a mule hauls the loaded cars from the top of the winze to the portal of adit. There are also at this adit a small compressor and blower, and pump and gasoline engine. In sinking this winze another coal bed was cut at an inclined depth of 80 feet. This has a total thickness of five feet of which two feet appears to be fairly clean coal and the balance mixed seams of coal, clay and bone. Twelve feet lower in the winze another layer is said to show one foot of good coal with other minor seams. No further coal beds had been reported up to the time of visit in March, 1926.

Subsequently, Rees stated that the incline was sunk to a depth of 353 feet, where rhyolite was struck without finding any more coal. In the upper workings, mentioned in the first paragraph, a raise was put up early in April, 1926, and encountered an upper bed of coal, near the surface. This is now being prospected.

G. H. Rees gives the following as a general average analysis of the coal prospected in this region, under his supervision :

Fixed carbon (after drying)-----	42%
Volatile hydrocarbons (after drying)-----	33-35%
Ash (after drying)-----	23-25%
Sulphur (after drying)-----	.75-1%
B.t.u.s -----	9000
Moisture -----	17%



Portal of incline on Luce property, being prospected by
Mt. Shasta Coal Company. Near Oak Run.

The accompanying map shows the location of coal prospects in central Shasta County, including those mentioned as having been worked 50 years ago, as well as those under lease or option to Cross and associates.

Work has also been done in the county on coal prospects on the upper course of Kosk Creek, and in the Beegum district in the southeastern part of the county.

Beegum Creek Deposit has been prospected by Don Noble, Platina, and D. F. Weed, Ono. It is in the $W\frac{1}{2}$ of Sec. 29 and $E\frac{1}{2}$ of Sec. 30, T. 29 N., R. 9 W., at an elevation of 2100 feet, 45 miles by road west of Red Bluff, and $4\frac{1}{2}$ miles by road and trail from Platina. The discoverers ran an adit 80 feet, on the coal for about 40 feet, with three feet of coal at the face. A raise put up 20 feet shows layers of coal from a few inches to two feet thick.

The coal is said to be hard and good quality, and has been used a little locally for blacksmith work. The seam strikes east and dips 18° south and is said to outcrop at intervals for two miles beyond this property. There is some water nearby in Coal Gulch, a branch of Beegum Creek. The distance from railroad makes the possibility of commercial development doubtful.

Bibl: Cal. State Min. Bur. R. XVII, p. 515.

Frost Prospect. Owners, Byron Frost and wife, Willows. It is in Round Mountain District. Similar to others described. Idle.

Kosk Creek Deposits were prospected many years ago but were not producers, due to being in rugged country remote from railroads.

In the $SE\frac{1}{4}$ of Sec. 22, T. 38 N., R. 1 E., at the old *Burckhalter Coal Prospect*, it is said that coal is exposed in the creek bed and along the banks for one-half mile. This is on one of the headwater branches of Kosk Creek, three miles south of the Siskiyou County line. While the writer did not visit the place Mr. C. O. Willis of Burney, who is familiar with the region, states the widest vein is 13 feet thick and that in all 23 seams of coal have been found here. Samples exhibited are black and apparently fair grade sub-bituminous (black lignite). The section of the widest vein is said to show the following:

roof, black and white sandstone
small seams coal
clay
 $7\frac{1}{2}$ feet coal
2 feet clay
 $5\frac{1}{2}$ feet coal

The deposit is about 10 miles from nearest point on present Pacific Gas and Electric Railway, but it is estimated 15 miles of railroad would be required to reach it on account of steep grades. It is at present accessible only by 14 miles of trail.

The *Scott Coal Prospect* is another showing three-fourths mile northwest of the last named, on another fork of the creek. It was prospected superficially years ago.

COPPER.¹By W. B. TUCKER, Mining Engineer.²

DESCRIPTION AND LOCATION OF COPPER DISTRICTS.

The copper region of Shasta County is about 30 miles in length and about 15 miles in width, extending nearly east and west across the Redding Quadrangle of the U. S. Geological Survey, and embraces three actively producing districts known as Iron Mountain, Bully Hill, and Ingot, which are separated by a dozen miles of country where as yet no large bodies of copper ore have been found.

The Iron Mountain district is the largest and by far the most important region. Iron Mountain lies just outside of the border of the Redding Quadrangle, northwest of the old town of Keswick, and from this locality the district extends nearly northeast for 25 miles to and beyond the Mammoth, and has a width of about two miles. It comprises the holdings of the Mountain Copper Company, Pittsburgh-Mount Shasta Mining Company, Balaklala, Trinity Copper Company, Colma Copper Company, Golinsky Copper, and a number of other smaller mines.

The Bully Hill district comprises an area scarcely three miles north and south by two miles east and west, and includes the Bully Hill, Rising Star, Arps, and Copper City lodes, besides a number of prospected claims on the south and southwest slope of Horse Mountain. (Plate I.)

The Ingot district, which is on the east end of the copper region, has an area of scarcely two miles north and south by three miles east and west, and includes the Afterthought, Donkey and Woodrow Wilson mines.

Geology. (Excerpts taken from Redding Folio, U. S. Geological Survey on geology of district.)

The country rock of the copper deposits is practically the same throughout the region, but not all the same age. It is chiefly rhyolite and tuff, and here and there a trace of included sediments.

Character of Ore Deposits. The copper ore deposits are lenses or zones of disturbance in which the country rock is crushed and sheared, thus producing the channels for circulating waters, and greatly enhancing the possibilities of the mineral solution and deposition.

Fissure Systems. The rocks of the copper region have experienced disturbances at many periods extending over a wide range of time. The system of fissures is confined to three groups: (1) The early fissures filled at least in part by igneous rocks of the pre-Cretaceous eruption, (2) the fissures bearing ore deposits, and (3) the fissures of the late Cretaceous or post-Cretaceous age.

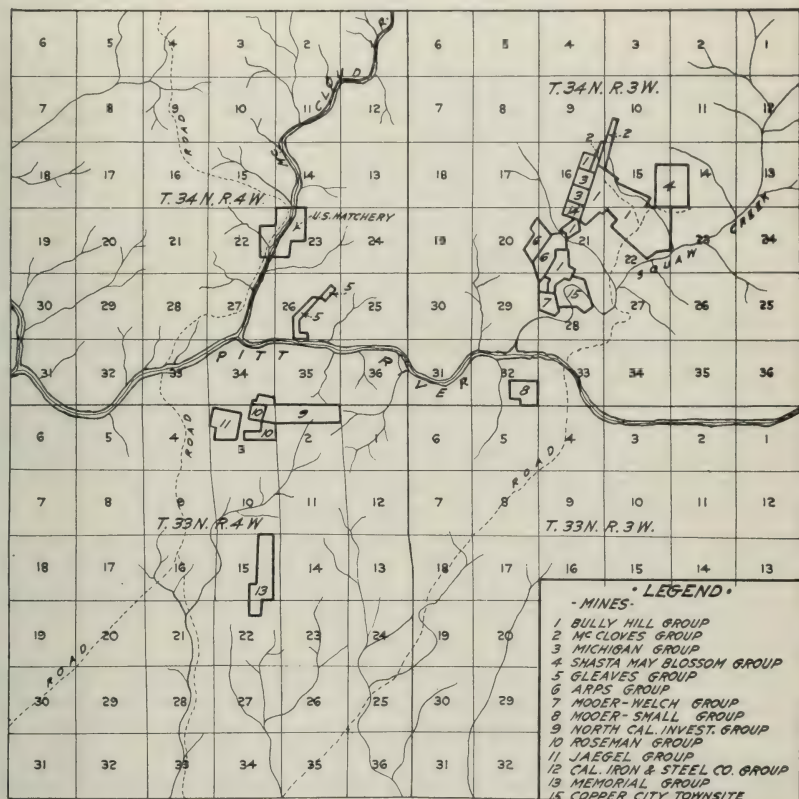
Ore-bearing Fissures. The fissures which gave access to mineral-bearing solutions, and thus permitted the formation of deposits of copper and auriferous quartz, originated chiefly during the epoch of

¹ This section on copper is a revision and reprint of an article published in our Report XX, pp. 419-447, 1924, with changes and additions needed to bring it to date.

² ACKNOWLEDGMENTS. The writer wishes to acknowledge the uniform courtesy extended him by owners and operators of mines throughout the Shasta Copper Belt.

rock crushing and mountain making about the close of the Jurassic. This is indicated by the fact that the fissures bearing ore have been found in the Jurassic rocks, but not in the Cretaceous. The important

PLATE I.



MAP OF A PORTION OF THE SHASTA COUNTY COPPER BELT EAST OF THE SACRAMENTO RIVER, INCLUDING THE BULLY HILL DISTRICT, SHOWING THE PRINCIPAL MINING PROPERTIES.

ore-bearing fissures of the copper districts are irregular in trend. The greatest extension of the copper region is in a direction about N. 80° E., while that of the several districts range from N. 50° W. to N. 30° E.

The general trend of the Iron Mountain district is N. 30° E., but the strike of its ore-bearing fissures rarely conforms to the general direction. The strike of the ore-bearing fissures about the head of Motion and Spring creeks varies, but the principal mineralized fissures usually have a course of N. 70° W., whereas on the north slope of Balaklala Mountain and beyond Squaw Creek their general course is nearly N. 70° E., though locally diverted.

The rocks in this region are much sheared, and in all parts of the district the fissures containing the ore deposits are usually those that show the greatest amount of shearing.

In the Bully Hill district the principal ore-bearing fissures have a course of about N. 10° E., parallel with the greatest extent of the producing district, although there are local variations of minor importance.

In the Ingot district the principal ore-bearing fissures have a general strike of N. 50°-60° W. The dip of the ore-bearing fissures throughout the copper belt is usually vertical or at a high angle, but there are a number of prominent variations, as at Shasta King and Mammoth mines, where the dip westward flattens and locally may be reversed.

Distribution of Ores. The principal orebodies of economic value have been found only in the Balaklala and Bully Hill rhyolites. These orebodies occur in irregular fissures along which there has been much shearing, and the orebody is as a rule irregularly lenticular in the shear zone. These lenticular orebodies range from a mere seam to a hundred feet in diameter. They succeed one another with the same irregularity in a more or less continuous shear zone, or occur in adjacent parallel shear zones. The maximum width of orebodies that have been worked is 300 feet, with a known length of 1000 feet.

Depths of Ore Deposits. The ore deposits have been developed throughout the district to a depth of 1500 feet below the surface.

Grade of Ore. The material mined in recent years does not average over 3 per cent copper.

Character of Ores and Gangue. The present ores of the copper region are almost exclusively sulphides, the metals contained being iron, copper, zinc, and small proportions of lead, arsenic, silver and gold. The minerals are pyrite, chalcopyrite, bornite, chalcocite, spalerite and galena. The upper portion of the orebodies consists largely of limonite.

Production.

The exploitation for copper in Shasta County began in 1895 at Iron Mountain, and the total production from 1895 to 1924, inclusive, is 646,964,136 pounds valued at \$104,381,973. About 6,000,000 tons of ore has been produced from the county's mines.

History.

Copper was discovered and mined in Shasta County at Copper City in 1862. It was not until 1895 that operations were started at the Iron Mountain Mine by the Mountain Copper Company, and this marked the discovery and development of the immense sulphide orebodies of the copper belt of Shasta County.

The principal productive mines on the west end of the copper belt have been Balaklala, Golinsky, Iron Mountain, Mammoth, and Shasta

King. On the east end of the belt are the Bully Hill and Rising Star mines at Bully Hill, and the Afterthought Mine at Ingot.

The copper mines of Shasta County have been under active operation from 1895 to 1919, and Shasta County led all other counties in California in the output of copper during those years; but in 1920-1922 production was small, recovering somewhat in 1923 and 1924. The history of the principal districts in the copper belt is briefly described according to the importance of the mines.

Bully Hill and Copper City Districts.

In 1863 about 250 tons of ore were shipped to San Francisco. This ore is said to have contained 8 per cent copper, with values of \$40 in gold and \$20 in silver. From San Francisco the ore was shipped to Swansea, and gave a small margin of profit. The ground now covered by the Bully Hill Group of Mines was first located by Alexander Sanford. Jack Killinger and J. P. Williams formed a company and operated the Excelsior Mine, located near Copper City, until 1865. At the same time, the Baxter Mine was operated by the Baxter Mining Company.

At Bully Hill, O. R. Johnson & Co. acquired the claims located by Sanford, and began operations under the name of the Bully Hill Gold and Silver Copper Mining Company. In 1877, Alvin Potter & Company reopened the Bully Hill Mine. Then the property passed to the Extra Mining Company, which built the first mill in Copper City in 1877. This company operated the property for three or four years, when operations were suspended on account of their inability to treat the base ores. About 1897, James Sallee obtained the Bully Hill Mine, and after three years of development work sold the property in 1899 to J. R. De La Mar for \$225,000. In 1901, the property was transferred to the Bully Hill Copper Mining and Smelting Company, of which J. R. De La Mar was president.

This company opened up the Bully Hill Mine, erected smelting works which then included a blast furnace with a daily capacity of about 150 tons, a converter plant of 150 tons, a battery of 60 roasting stalls, and two McDougall roasters. The first ores treated by this plant are reported to have carried as high as 15 per cent copper. During the operation of the plant by this company, the average ore treated is stated to have been around 5 per cent copper.

In 1905 the property was sold by the De La Mar interests to the General Electric Company. The General Electric Company opened up the Rising Star Mine, besides doing additional development work on the Bully Hill Mine. The smelting works were enlarged and smelting operations resumed.

The Sacramento Valley and Eastern Railway was completed from Pit, a station on the Southern Pacific, to Bully Hill. The smelter was operated by the General Electric Company until 1910, after which only development work was done. The company built a small experimental plant to try out electric smelting and recovery of the zinc values. This plant was operated in 1915, producing 300 to 400 lbs. of metallic zinc per day, using direct electrolysis of zinc sulphate with regeneration of acid.

In October, 1917, the W. Arnstein interests, known as Bully Hill Mining Company, took over the property; the Rising Star shaft was

repaired, and silver-gold-copper ore extracted from the lower levels was shipped to the Mammoth smelter at Kennett. The production in 1918 amounted to 27,000 tons of selected ore, averaging 6 per cent copper and \$1 in gold and silver per ton. The property was operated until 1920 by W. Arnstein, who built a 150-ton flotation plant, but this treatment was unsuccessful. In 1920 the property was sold to the Shasta Zinc and Copper Company, D. C. Jackling, president, and W. Arnstein, vice president.

The Shasta Zinc and Copper Company constructed a 150-ton reverberatory smelter and zinc oxide plant, and the plant was put in operation in June, 1922, and operated until December, 1922, when operations were suspended due to fall in the price of zinc oxide.

Iron Mountain District.

The Iron Mountain or Mountain Copper Mine was discovered in the early sixties, and located by William Magee and Charles Camden of San Francisco, as an iron mine. It was held as an iron deposit until 1879. In that year James Sallee and Alvin Potter acquired a one-third interest in the property, and operated the mine for its gold and silver values. In 1884, John O. Earl and Charles Ellsworth bonded the property, and placed a 20-stamp mill on it. Before any production was made, the entire plant and mine were returned to the original owners. James Sallee, as part owner and superintendent, operated the mine until 1888, when it was purchased by the Mountain Mines Syndicate, Ltd., of London, England. This company extended one of the prospect tunnels, encountered and developed a large body of copper-sulphide ore, and proceeded to operate the mine as a copper mine.

On January 1, 1897, the entire property of the Mountain Mines Syndicate was transferred for \$5,750,000 to the present Mountain Copper Company, Ltd., of London. The Iron Mountain Mine was operated continuously until 1920, when operations were suspended.

The Mountain Copper Company also owns and operates the Hornet Mine, lying to the north of the Iron Mountain Mine. On this property 5,000,000 tons of pyrite ore have been developed, averaging 0.7 per cent copper, and carrying 47 to 50 per cent sulphur. This mine has been under continuous operation, daily production being from 400 to 500 tons of pyrite ore.

The company also owns and operates a 350-ton smelter at Martinez, California, and a 150-ton leaching plant. At this plant the Hornet ores, low in copper but rich in sulphur, are burned and the sulphur fumes are collected in lead-lined chambers and transformed into sulphuric acid by the Meyer chamber process; the cinder remaining after roasting is leached for its copper content. The acid is sold crude, and is also used as the basis of commercial fertilizers. The fertilizer plant was operated to full capacity in 1920, and a gas purifier, bluestone and pigments made. At one time this company was among the large copper producers of the world. Between 1901 and 1919, they produced over 122,000,000 lbs. of fine copper.

The Mammoth Mine, which is located in the Iron Mountain district, has been the largest producer of copper in the Shasta copper belt. This property, which originally consisted of twelve claims and a patented section, was owned by R. M. Saeltzer and associates of

Redding. In 1904 it was purchased by the Mammoth Copper Mining Company, a subsidiary of the U. S. Smelting, Refining, and Mining Company, Boston, Massachusetts. The smelter located at Kennett was built in 1905, and in 1908 the plant was enlarged to its present capacity. The mine and smelter were under continuous operation until May, 1919.

The Balaklala Mine was developed by the Balaklala Mining Company of San Francisco, in 1900. In 1902 the Western Exploration Company secured a bond on the property and carried on extensive development work until 1905, when it was acquired by the First National Copper Company and operated under the name of the Balaklala Consolidated Copper Company, New York City, from 1906 until May, 1919, when operations were suspended. The mine was taken over under lease by the Mammoth Copper Company in 1923, and reopened in November, 1923, the ore going to the Mammoth smelter. At present it is under lease to Mason Valley Mines Company.

Ingot District.

The history of the mines in the Cow Creek or Ingot district has been in many respects parallel to that of Iron Mountain and Bully Hill. The earliest attempts at operation were made for the extraction of gold and silver values from the oxidized surface ores. Later, effort was made to work the basic ores by a process of roasting and milling. C. M. Peck, in 1872, obtained for a nominal sum the property afterward known as the Peck Mine, and now included in the Afterthought Mine, and began its successful operation upon the oxidized surface ores. In 1875 he erected a small reverberatory furnace, and later on a small water-jacket furnace was erected. Due to the refractory character of the ores treated, attempts to smelt the ore in these furnaces were unsuccessful. In 1903 the Great Western Gold Company acquired the property and installed a 42- by 150-inch water-jacket blast furnace having a capacity of 250 tons which was operated successfully. The smelter was blown in in 1905. In 1909 the property was acquired by the Afterthought Copper Company. This company installed a 300-ton reverberatory furnace, which was blown in in July, 1919; also a 300-ton differential oil flotation plant. The property was operated continuously until February, 1920, when operations were suspended. In February, 1925, California Zinc Co. began mining.

MINES.

Afterthought Mine. The property is located in Secs. 10, 11, 25 and 5, T. 33 N., R. 2 W., near the town of Ingot, which is 24 miles northeast of Redding. Holdings of the company consist of 1650 acres, of which 1550 acres are patented.

Late in 1923 the property was sold under foreclosure to Forest P. Tralles, of St. Louis, assignee of the executors of the will of J. T. Milliken, who it is said had advanced the Afterthought Copper Company over a million dollars. In February, 1925, California Zinc Company began mining ore under lease and option. J. F. Dugan, general manager, Bully Hill.

The 300-ton selective flotation plant which had been previously installed by Afterthought Copper Company under the management of Milliken, proved to be a failure, as the zinc and copper sulphides could

not be cleanly separated. California Zinc Company has abandoned the plant and reverberatory smelter, and are sending the ore from this mine to Bully Hill for concentration, over a new aerial tram $8\frac{1}{2}$ miles long. The tram and the concentrating process now in use are described under Zinc in this volume. The vertical depth is 800 feet. A new shaft has been raised from the seventh to fourth level and the orebodies formerly developed are being mined. Besides the shaft and winze workings where levels are run 100 feet apart, there is a main working adit, No. 4, which runs N. 85° E. 600 feet, then as a drift 500 feet southeast on the Afterthought lode and 400 feet northwest on Copper Hill lode. Zinc is now the principal product of the mine.

Ore deposits: The copper-zinc ore deposits are limited to zones of disturbance in which the country rock is crushed and sheared. The Copper Hill lode consists of two short, nearly vertical orebodies, approximately 350 feet apart. They lie close to the contact in rhyolite that encloses fragments of slate. The shear zone contains massive irregular lenticular orebodies. The two vein systems or lodes are known as the Afterthought and Copper Hill lodes, which strike northwest and dip 70° to the northeast. Approximately 300,000 tons of ore are reported to be developed, carrying 5.5 ozs. silver, 0.03 oz. gold, 16% zinc and 3 copper. The ore is a complex copper-zinc ore finely disseminated, composed largely of sphalerite, pyrite, chalcopyrite, and local traces of bornite. The gangue which forms less than 5% of the ore is barite, with some quartz and a trace of calcite.

Bibl: Cal. State Min. Bur. R. XIV, pp. 760-761; R. XVIII, pp. 596-598; R. XX, pp. 425-426. Bull. 50, pp. 102-105. A. H. Heller, M. & S. P. Aug. 2, 1919.

Akers Group of Mines is located in Secs. 6 and 7, T. 33 N., R. 5 W., 5 miles west of Kennett, in the Backbone mining district. Elevation 1000 feet. J. W. Akers of Kennett, owner. Holdings comprise fourteen claims, totaling approximately 280 acres, located along Squaw Creek, between the Mammoth and Balaklala mines, and adjoining the Trinity Copper Company's property on the east. The development work on these claims is confined to five tunnels along an intrusion of quartz-augite-diorite, about 200 to 300 feet in width, with a general easterly trend, which occurs in the Balaklala rhyolite. The gossan crop-pings are prominent and can be followed for about 1000 feet. The ore occurs in small irregular lenticular orebodies, along irregular fissures, one of which trends north and south, with a dip of 60° east, the other having a N. 40° W. trend. The ore is chiefly pyrite with more or less chalcopyrite and occasional traces of bornite, and carries \$2 per ton in gold and silver. The present work is confined to No. 3 tunnel, where a series of parallel north and south and a N. 40° W. fracture are being drifted on; and some small lenses of ore have been exposed along these fractures, varying in width from 2 inches to 2 feet, and from 10 to 15 feet in length. In this tunnel there is a drift 261 feet north on a north and south fracture, and one to the south 244 feet on a parallel fracture. In this south drift the main N. 40° W. fissure was cut. On the claims located on the south side of Squaw Creek are two tunnels which have lengths of 100 feet. In the lower tunnel, which is driven on a N. 40° W. fracture, a small lens of ore 40 feet in length and about 2 feet in

width has been developed. Samples taken from this orebody are reported to carry from 2% to 6% copper. One man employed on development work.

Bibl: Cal. State Min. Bur. R. XX, p. 426.

Arps Group of Mines is located in Secs. 20, 21, 28 and 29, T. 34 N., R. 3 W., $1\frac{1}{4}$ miles north of Copper City, in the Pittsburg mining district. It comprises fifteen patented claims, totaling 250 acres adjoining the Copper City claims of the Shasta Zinc and Copper Company. Owners are William Arps and R. M. Saeltzer of Redding. Elevation 900 to 1200 feet. The property is located on the Copper City lode, the shear zone in which the lode occurs traversing the Bully Hill rhyolite and having a general course of N. 30° W. The ore is pyrite, sphalerite and chalcopyrite, with barite as a gangue. Developments consist of six tunnels, two shafts and several crosscuts and winzes aggregating over 3000 feet. The most extensive workings are confined to the Globe, Hearst, and Kaiser Wilhelm claims. In these workings several small lenses of ore were developed, carrying values in copper, gold and silver. Several cars of ore have been shipped from the property to the Mammoth Smelter at Kennett, and are reported to have averaged \$20 per ton in gold and silver, with low copper content. Equipment consists of blacksmith shop and tools, compressor house, Chicago pneumatic compressor, air drills, cars and track. Idle.

Bibl: Cal. State Min. Bur. R. XIV, p. 761; XIX, pp. 89, 90; XX, p. 427. Bulletin No. 50, p. 110.

Balaklala Copper Mine consists of 72 patented claims, 1169 acres; also 800 acres of smelter and townsite land at Coram, in the Flat Creek mining district, in Secs. 10, 11, 12, 13, 14, 17, 20 and 21, T. 33 N., R. 6 W., about three miles northwest of Coram Station. Owned by First National Copper Company; office, 111 Broadway, New York. Officers, Thomas W. Lawson, president; W. A. Kerr, secretary, until May, 1919, when all operations were suspended. Under lease to the Mason Valley Mines Co., Thompson, Nev. The mines are located on the south side of Squaw Creek, at an elevation of 2400 feet. The country rock is rhyolite, ore occurring in lenticular masses as replacement of country rock in flat bodies, with slight dip to north, the greatest extension being to the east and west, with a series of north and south step faults, causing displacement from a few feet to more than 100 feet. The main ore-bearing fissure strikes N. 70° E., with a northwesterly dip somewhat steeper than the slope on which it occurs. The lode is well marked in places by heavy gossan, and has been traced more or less continuously for over a half mile. The main orebodies are developed for lengths of 900 and 1100 feet. The ore is cupriferous pyrite, copper values being mainly in chalcopyrite, with a little chalcocite and covellite, all carrying gold and silver values and said to average about 2.7% copper, 0.9 oz. silver, 0.03 oz. gold, 21.4% silica, 31.5% iron, 4.3% lime, 3.4% alumina, 2.2% zinc and 35.2% sulphur.

Developments consist of 20 tunnels, of which the main haulage tunnel, known as the Wiel, is 6000 feet in length, and has a large glory hole.

Ore reserves are said to be about 3,000,000 tons of 2.7% copper ore with 0.95 oz. silver and 60¢ gold per ton.

Production June 30, 1918, to May 15, 1919, amounted to 82,271 tons of ore, the net recovered values being 2.7% copper and \$1.54 gold and silver, or a total of \$178,352, copper being sold at 19.59¢ per pound. For the year 1917-1918, the mine produced 82,876 tons of ore assaying 2.29% copper, \$1.57 in gold and silver, which compares with the previous year's production of 76,559 tons, netting \$174,656. Shipments were made to the Mammoth smelter at Kennett. The smelting plant which was located at Coram has been dismantled and the material sold to the Shasta Zinc and Copper Company at Winthrop.

Mine equipment consists of hoists, 5 air compressors, air drills, electric tramway, motors, cars and track, ore bunkers (capacity 1000 tons), and 16,500 feet of aerial tramway from the mine to Coram.

Buildings include an office, store, school, hospital, sawmill, and about 75 dwellings.

The Mammoth Copper Company resumed operations on the mine in November, 1923, but worked only a short time. In March, 1926, Mason Valley Mines Co. leased the mine and put 10 men at work.

Five to eight tons per month of copper precipitate, assaying 50% copper, is recovered from the mine water.

Bibl: Cal. State Min. Bur. R. XX, pp. 427-428.

Baxter-Winthrop Group, formerly known as Copper City Mine, owned by Shasta Zinc and Copper Company, comprises the Excelsior, Brown, Humboldt and Baxter claims, located in Secs. 21 and 28, T. 34 N., R. 3 W., 1 mile north of Copper City, in Pittsburgh mining district. Developments consist of 3000 feet of tunnels and 1000 feet of drifts. The lower tunnel, known as the Winthrop tunnel, was driven northeast 1000 feet, developing an orebody which was stoped to the surface. On the Baxter Claim, in Baxter Gulch, there is a shaft 150 feet deep, which is connected by drifts with the workings from the Winthrop tunnel. All workings caved. Idle.

Bibl: Cal. State Min. Bur. R. XX, p. 428. Bulletin No. 50, p. 107.

Black Diamond Group of Mines. This group, consisting of a half section of land and eighteen claims, is located in Secs. 2 and 3, T. 33 N., R. 4 W., in the Stillwater mining district. Formerly operated by Northern California Investment Company, George Bayha, vice president and agent, Redding, California.

The ore on these claims occurs on the contact of McCloud limestone and quartz-augite-diorite, and at a number of points small masses of ore have been found along this contact. The orebodies discovered are small and irregular. The ore consists of chalcopyrite, pyrrhotite and magnetite. A large amount of development work has been done on the property, consisting of a number of tunnels. Idle.

Bibl: Cal. State Min. Bur. R. XX, p. 428. Bulletin No. 50, p. 108.

Brushy Canyon consists of 160 acres in Sec. 34, T. 34 N., R. 3 W., about two miles south of Copper City, in Pittsburgh mining district. Owners, W. Collins et al. Development consists of one tunnel 300 feet long. Idle.

Bibl: Cal. State Min. Bur. R. XX, p. 429. Bulletin No. 50, p. 102.

Bully Hill and Rising Star Mines. These properties are situated one and one-half miles north of Copper City, in Secs. 15, 16, 21 and 28, T. 34 N., R. 3 W., in the Pittsburgh mining district. Owned by Shasta Zinc and Copper Company, 1800 Hobart Building, San Francisco; D. C. Jackling, president; W. Arnstein, vice president; M. W. Enrich, secretary; G. T. Jackson, general manager; Louis Monohan, mine superintendent. They are being operated under lease and option by California Zinc Company.

At Bully Hill, there are two lodes that have been extensively worked, the Eastern or Delamar lode in the Bully Hill Mine, and the Western or Anchor lode in the Rising Star Mine. The general course of the lodes is N. 10° E.; dip, approximately vertical. They are almost parallel and are about two hundred yards apart. The shear zones in the rhyolite are more or less distinct throughout, and contain irregularly lenticular overlapping orebodies. These orebodies vary in extent and size from lenticular or sheet-like nodules a few inches wide, up to bodies of ore 100 feet in length and 12 to 30 feet thick. The greatest extent of the orebodies appears to be in a nearly vertical direction, pitching steeply north. The ore is composed of pyrite, chalcopyrite, chalcocite, mornite, sphalerite, and galena in varying proportions. The ore mined in the Rising Star Mine is principally sphalerite and some pyrite and chalcopyrite. Quartz is scarce in the gangue, and barite is more common, particularly in ore that is rich in copper. The average content of ore mined from the Rising Star Mine is about 22% zinc, 2% copper, 2 ounces silver, and 60¢ in gold. Since 1917 all development work has been confined to the Rising Star Mine. A series of lenticular orebodies have been opened up on the 5th, 6th, 7th, 8th and 9th levels.

Developments: The Bully Hill Mine has been opened by a number of tunnels with extensive drifts, crosscuts and raises, comprising several thousand feet. There are nine levels 100 feet apart, eight raises from 50 to 560 feet in height, and an 1100-foot crosscut tunnel on the Bully Hill Claim, about 600 feet below the gossan outcrop. At 1100 feet from portal of the tunnel, where the vein was cut, a 3-compartment shaft was sunk to a depth of 950 feet. No. 3 or main tunnel level is connected by chutes and raises with the upper workings, of which some of the drifts run along the lode 800 to 1000 feet.

Rising Star Mine. The underground workings were unwatered in 1917, the shaft repaired, and a large amount of development was done from 1917 to 1922, opening up a series of lenticular orebodies on the 5th, 6th, 7th, 8th and 9th levels. It is reported that 300,000 tons of ore have been blocked out. During 1918 and 1919, silver-gold-copper ore was shipped from the lower levels to the Mammoth smelter at Kennett.

Developments: There is a 3-compartment shaft 800 feet deep. The main adit tunnel (No. 5 level) intersects the shaft 219 feet below the collar, with six levels below No. 5 level, 100 feet apart, with drifts on the 6th, 7th, 8th and 9th levels. Ore is trammed through No. 5 level to storage bins, then hauled in cars by horses one-half mile to bins at the smelter at Winthrop.

Mine equipment: Electric hoist, 10-drill Ingersoll-Rand compressor, driven by 60-h.p. motor, blacksmith shop, and timber-framing shop. Mine water is handled by two 5- by 9-inch Aldrich quinplex pumps, each driven by 100-h.p. motor; one pump on 9th level, the other on

11th level. Electric power is secured from the Pacific Gas and Electric Company.

Smelter: The 400-ton smelter, idle since 1910, has been dismantled and moved to Winthrop. Some parts of it were salvaged and used in the construction of the zinc oxide plant. During 1920 to 1922, a reverberatory and zinc oxide plant having a capacity of 150 tons per day was constructed on this property. The plant was put in operation during the early part of June, 1922, and operated until December, 1922, when the plant was closed down due to fall in price of zinc oxide.

In August, 1924, the California Zinc Company was organized to take over the Bully Hill mine and smelter from the Shasta Zinc and Copper Company. J. F. Dugan, general manager.

This company abandoned the process used by the last operators (described in our Report XX, pp. 430-432) and have lately been making a bulk concentrate, as described herein under Zinc. Copper is at present a by-product.

Bibl: Cal. State Min. Bur. R. XIII, p. 62; XIV, pp. 763-764; XX, pp. 429-432. Bulletin 50, pp. 106-107. U. S. Geol. Surv., Redding Folio.

Colma Copper Group of Mines is located in Secs. 6 and 31, T. 33 and 34 N., R. 5 W., 6 miles west of Kennett, in the Backbone mining district. It lies between the Uncle Sam and Mammoth holdings, at an elevation of 2400 feet. Owners are M. E. Dittmar of San Francisco and Louis Monahan of Winthrop, California. The property was in 1924 under bond to the American Zinc, Lead and Smelting Company, 1012 Pierce Building, St. Louis, Missouri. C. B. Nichols, superintendent.

This group of claims was being developed through No. 5 tunnel level of the Uncle Sam Mine, with the hope of picking up the direct extensions of the Mammoth Mine ore trends along the so-called 'California Fissure' or shear zone. The trend of the tabular ore deposition has been developed in the Mammoth Mine from the point of original exposure for a distance of approximately 5000 feet through the Mammoth property towards the Colma copper boundaries. The course of the No. 5 tunnel level of the Uncle Sam Mine is N. 40° E., and it intersects the Uncle Sam vein 1200 feet from the portal. About 350 feet beyond this vein, a vein of quartz 3 feet in width was cut, which is heavily mineralized with chalcopyrite and pyrite. The crosscut tunnel has been driven ahead 1800 feet beyond the Uncle Sam vein, and the company plans to continue driving the crosscut to intersect the Mammoth ore fissure. The formations cut by this tunnel were quartz-porphyry and rhyolite.

Equipment: A 10 x 12-inch Ingersoll-Rand compressor driven by a 50-h.p. motor, air drills, cars, blacksmith shop, and dwellings. Electric power is secured from the Pacific Gas and Electric Company. Eight men were employed in 1924.

Bibl: Cal. State Min. Bur. R. XX, p. 432.

Donkey Mine consists of two patented claims comprising 40 acres in Sec. 11, T. 33 N., R. 2 W., in the North Cow Creek mining district, about two miles northeast of Ingot, and in the Shasta Forest Reserve. Owner, Afterthought Copper Company. Idle.

Bibl: Cal. State Min. Bur. Bull. No. 50, pp. 105-106; R. XIV, p. 765; XX, p. 432.

Golinsky Group, formerly known as Little Backbone, is located in Sec. 28, T. 34 N., R. 5 W., about four miles from Kennett, in the Backbone mining district. Owner, Mrs. B. Golinsky of San Francisco, California.

Holdings consist of 300 acres, patented, adjoining the Mammoth Mine on the east. The orebody developed extended 150 feet N. 70° E., dipping southeast, and to a depth of not over 100 feet. This orebody is approximately parallel to the Mammoth orebody. Formation is Balaklala rhyolite.

Workings consist of several tunnels, one being 800 feet in length, 400 feet of drifts and one stope. Ore bins and dwellings on the property. Produced \$70,000. Idle.

Bibl: Cal. State Min. Bur. Bull. No. 50, p. 100; R. XIV, p. 766; XX, p. 432.

Greenhorn Mine. Owners, Atascadero Mining Company, 1014 Hobart Building, San Francisco, California; E. G. Lewis, president; C. E. Gilman, secretary; Albert Hanford, consulting engineer. The property is located in French Gulch mining district, in Sec. 6, T. 32 N., R. 7 W., 22 miles northwest of Redding. Elevation 2000 feet. Holdings consist of 15 patented mining claims and 120 acres of patented land. Total area of 420 acres.

The country rock is quartz-porphyry. The ore occurs as lenticular orebodies in a shear zone in altered rhyolite which strikes N. 60° W., with dip of 40° W., and is mainly chalcopyrite or pyrrhotite with some suprite in the upper workings, as well as malachite and azurite. Principal ore mined is chalcopyrite associated with pyrrhotite and pyrite. Some beautiful specimens of native copper were discovered in the upper workings of the mine. Orebodies developed varied from thin seams to 10 feet in thickness. Management claims 250,000 tons of 3% ore blocked out.

Development consists of six tunnels totaling over 3000 feet, the greatest depth of workings below the outcrop being 480 feet.

Equipment: Ingersoll-Rand 10 x 12-inch compressor, air drills, cars, blacksmith shop, and bunk houses. Compressor was driven by electric motor. Electric power secured from the Pacific Gas and Electric Company. Idle.

Bibl: Cal. State Min. Bur. R. XVII, p. 518; XX, p. 433.

Keane Copper Mines. Owners, Harry J. Keane, 3028 West Street, Oakland, C. A. Peterson, George A. Greenwood, Miss Bertha Johnson et al. Comprises 42 claims in the old Pittsburg district, in Sec. 4, T. 36 N., R. 3 W., and Sec. 34, T. 37 N., R. 3 W., 12 miles by trail from Sims Station on east side of McCloud River. They were located in 1925. The elevation of claims is 1400 to 4800 feet.

Assessment work consisting of seven adits from 20 to 135 feet long, four small open cuts and 2½ miles of trail, are reported to have been done. Seven men were employed during the summer of 1925 and three are working now (April, 1926).

The claims were not visited, but according to Keane, narrow veins of high grade copper ores occur in 'mineralized lava.' Samples said to come from the claims show good grades of chalcocite, chalcopyrite and malachite, and a little native copper. A chalcocite seam now being fol-

lowed is said to be eight inches wide, and a vein of chalcopyrite is nine inches wide at the outcrop.

Kosk Creek Mine consists of 12 claims in Sec. 23, T. 37 N., R. 1 W., on Kosk Creek, near the 'big bend' of Pit River, at 2000 feet elevation and several miles north of the copper belt. Owners, W. Murray et al. Idle.

Bibl: Cal. State Min. Bur. R. XIII, p. 63; XX, p. 433. Bull. No. 50, p. 108.

Little Nellie Mine is located southeast of the Iron Mountain and Hornet Mines of the Mountain Copper Company, eight miles northwest of Keswick. Holdings consist of the Alleghany and Bennington groups, 30 patented claims. Area 575 acres in Secs. 27 and 35, T. 33 N., R. 6 W., in the Flat Creek mining district. Elevation 2400 feet. Owners, Pittsburgh and Mount Shasta Gold Mining and Milling Company; J. J. Schneider, president; T. V. Scott, secretary and managing director. Offices, 516 Federal St., Pittsburgh, Pa.

The mine was opened and worked for gold in the early days; however, all the later development has been in prospecting for orebodies carrying copper. Three parallel quartz veins known as the Little Nellie, Yorktown and Yorktown No. 2, occur in quartz-diorite. These veins strike N. 60° E. and dip 70° N. Width is 2 to 4 feet. The principal development has been confined to the Little Nellie and Yorktown veins. Stated production is \$160,000 in gold.

Developments: Upper tunnel driven on the Little Nellie vein a distance of 1125 feet; lower tunnel driven on the Yorktown vein a distance of 3888 feet, with crosscuts driven to the Little Nellie vein. The upper and lower workings are connected by a shaft which is located 1600 feet from the portal of the tunnel. From this point a crosscut has been driven north 2260 feet, at which point a vertical winze has been sunk 522 feet deep. This winze cut some small lenses of ore, showing chalcopyrite associated with pyrite. No extensive orebodies were encountered in crosscut or winze.

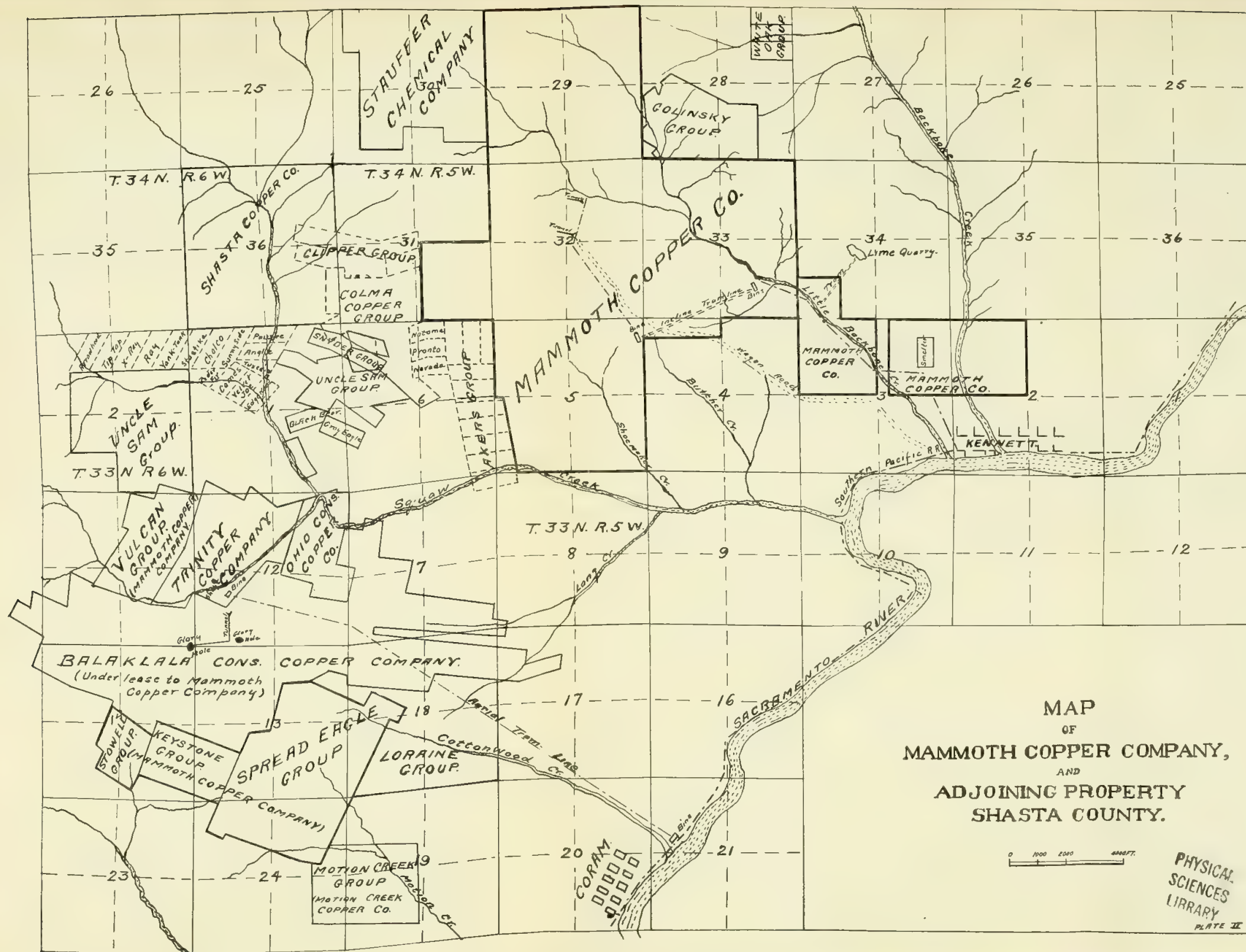
Equipment consists of 25-h.p. hoist (10 by 9 by 10-inch), Sullivan compressor driven by 50-h.p. motor, carpenter and blacksmith shops, and dwellings, and 15-stamp mill. Two men are employed.

Bibl: Cal. State Min. Bur. R. XX, p. 433.

Mammoth Copper Mining Company is a subsidiary of the U. S. Smelting, Refining and Mining Company, 55 Congress St., Boston, Mass. Mine office at Kennett, Shasta County, Cal. R. E. Hanley, superintendent. The Mammoth Copper Company was one of the largest producers of copper metal in California, and owns the most productive mines in the Shasta copper belt. The properties owned by the company are located in Secs. 2, 3, 29, 31, 32 and 33, T. 33 and 34 N., R. 5 W., about 4 miles northwest of Kennett. Elevation 3000 feet.

Properties: The Mammoth Group, which is the principal property, comprises 1117 acres, patented, and 434 acres, unpatented. The company also owns and operates the following properties (Plate II):

Anderson Group, consisting of 15 claims, 260 acres unpatented; Butters section, comprising 2719 acres; Crystal Group, 24 claims, 480 acres; Friday-Lowden Group, 150 acres patented, 188 acres unpatented; Keystone, 8 claims patented, 160 acres; Little Mammoth, 57 acres patented; Sheridan Group, 45.7 acres patented; Spread Eagle Group,



patented; Sheridan Group, 45.7 acres patented; Spread Eagle Group,

22 claims, 163 acres patented; Stowell Group, 10 claims, 188 acres of which 128 acres are patented; Vulcan Group, 10 claims, 200 acres patented. The company also owns a 195-acre patented smelter site one-half mile north of Kennett; 184-acre patented town site, and 657 acres in additional tracts.

Mines.

Crystal Group. Consists of 23 unpatented claims and is located in Sec. 11, T. 33 N., R. 6 W., in the Flat Creek mining district, adjoining the Balaklala on the north, the Vulcan on the west, and about $3\frac{1}{2}$ miles northwest of Coram. Owners, Mammoth Copper Company. Development by tunnels aggregates 200 feet. Idle.

Bibl: Cal. State Min. Bur. R. XIV, p. 764.

Friday-Lowden Mine. Located one mile southwest of the Mammoth Mine. Development on the property has revealed one orebody 60 feet above the main crosscut tunnel, the strike of this body being N. 40° W., with a dip of 35° NE. The orebody extends up to the 670-foot level of the Mammoth workings. A winze has been sunk on this orebody from the 670-foot level to the Friday-Lowden tunnel level. The ore is chalcopyrite and pyrite, with quartz and barite as gangue.

Developments consist of a crosscut tunnel 4000 feet in length, with 1000 feet of crosscuts and drifts.

Keystone Mine. Located in Sec. 14, T. 33 N., R. 6 W., adjoining the Balaklala Mine on the south and the Stowell on the east. Elevation 3000 feet.

Development consists of two tunnels, the upper tunnel being driven S. 30° W., 300 feet, and the lower tunnel being driven S. 30° W., 2000 feet, with 2000 feet of drifts and crosscuts, the most extensive orebody being found 50 feet above the lower tunnel. The orebody is 100 feet in length, 50 feet thick, and strikes north with a dip to the east. It was developed during 1918. The ore is chalcopyrite associated with pyrite. It is stated that there are 20,000 tons of ore carrying 3% copper on the dump.

Equipment: 4-drill Laidlaw-Dunn compressor driven by 50-h.p. motor, air drills, ore cars, blacksmith shop, and dwellings.

Mammoth Mine. The Mammoth lode exposed in the Mammoth Mine has a course of N. 80° E., and has been followed for about 5000 feet. The principal orebody developed had a length of 800 feet and a depth of 200 feet from the upper gossan croppings. This orebody dips 30° NW. The orebodies consist of a series of long, flat-lying lenses, occurring irregularly in shear zones in the rhyolite. The ore is composed chiefly of pyrite, chalcopyrite, and sphalerite. Quartz is the gangue mineral, although much of the ore is a heavy sulphide only showing a trace of quartz. Ore as mined in recent years is said to average 3% copper with \$2 in gold and silver.

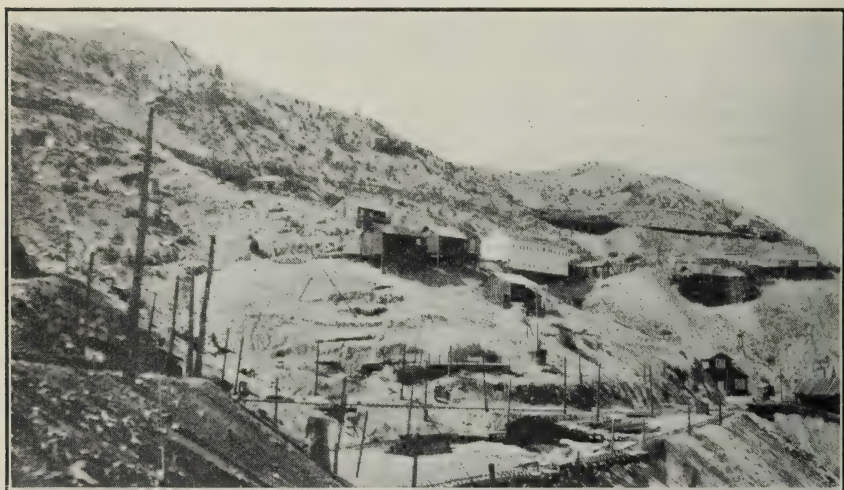
Developments consist of 5 tunnels, No. 5, the main haulage tunnel, being 2500 feet long. It is known as the 500-foot level. The tunnel is 8 by 10 feet and contains a 3-foot gauge track, 56-lb. rail with electric haulage. No. 3 tunnel (300-foot level) is driven west 5000 feet to the shaft which from this level has a depth of 500 feet, with levels at 540, 670 and 780 feet. On the 540-foot level an orebody has been developed which strikes northeast. It is 30 feet thick by 250 feet in length.

Total of underground workings amount to 60,000 feet. It is stated that there are probably 25,000 tons of ore developed above the 500-foot level.

Spread Eagle Mine. Located in Sec. 13, T. 33 N., R. 6 W., and adjoins the Balaklala and Keystone mines on the east. The general trend of the ore fissures developed on this property is N. 70° W., and dip 75° SW. The ore is capped by a large mass of gossan on the steep slopes at the head of Motion Creek. The ore developed beneath the capping is pyrite with occasional small masses of chalcopyrite.

Development work consists of eight tunnels, aggregating about 3000 feet.

Stowell Mine. Located in Sec. 14, T. 33 N., R. 6 W., one-half mile west of the Spread Eagle Group, and adjoins the Keystone Mine on the west. Elevation 3100 feet. On the slope of the ridge north of Spring Creek, there is a large mass of gossan which has a general course of northeast. Crosscut tunnels driven into the ridge below the gossan



View of Mammoth Mine, Mammoth Copper Company, Kennett, Shasta County.

croppings have exposed a massive body of pyrite ore. This orebody has apparently a course of N. 40°-60° W. The main tunnel is approximately 2000 feet in length. Other tunnels on the property aggregate about 800 feet. It is reported that ore reserves developed amount to 40,000 tons of 3% copper ore carrying \$1.50 in gold and silver per ton.

Equipment: Aerial tram from the mine to the bunkers at the Balaklala Mine.

Sutro Mine. Located in Sec. 29, T. 34 N., R. 5 W., one mile north of the Mammoth Mine and adjoining the Summit Mine on the east. It is situated on the eastern slope of Bohematosh Mountain, at an elevation of 3000 feet. The tabular orebody developed occurs along a shear zone with a course of N. 70° E., and a dip to the southeast. The orebody is 25 to 50 feet thick and about 200 feet in length. The main working tunnel is driven north 2000 feet. No ore was found on this level, but the ore zone was encountered in an upraise from this level. On the northeast slope of the mountain there is a tunnel driven southwest

about 1500 feet, at an elevation about 200 feet above the main tunnel. This tunnel intersected the orebody. There is another tunnel about 150 feet above this latter tunnel which was driven south 500 feet, developing some chalcopyrite associated with pyrite. Ore reserves are reported to be 40,000 tons, carrying 3% copper with \$2 in gold and silver per ton. The workings are connected with the Mammoth Mine by a tram line $1\frac{1}{2}$ miles in length.

Equipment: 20-h.p. electric hoist, Ingersoll-Rand compressor driven by 100-h.p. motor, blacksmith shop, and camp buildings.

Vulcan Mine. Located in Secs. 11 and 12, T. 33 N., R. 6 W., and adjoins the Shasta King Mine on the west. Holdings consist of 12 claims.

Developments consist of a crosscut tunnel driven north 1500 feet from the south fork of Squaw Creek. There are three other tunnels at a higher elevation. Some massive pyrite ore was developed in the



View of the Sutro Mine, Mammoth Copper Company, Kennett, Shasta County.

upper tunnels but no ore was developed in the main crosscut tunnel. Idle.

Ore Transportation System.

The ore from the Keystone and Stowell mines was transported by aerial tram to bunkers at the Balaklala Mine, then by aerial tram to Coram, from which point it was hauled by train over the Southern Pacific tracks to the smelter at Kennett. Ore from the Sutro Mine was trammed by mules to bunkers at the Mammoth Mine. The ore from the Mammoth Mine was drawn from mine chutes on the 500-foot level, into narrow-gauge railroad cars, and taken over a 2-mile electric railroad equipped with two 25-ton electric locomotives, six 25-ton steel gondola cars, and nine 10-ton flat cars to ore bins with a capacity of 1000 tons. From these bins the ore was taken over an incline gravity railroad in skips to another set of bins. The gravity railroad has a length of 4000 feet and a drop in this distance of 1700 feet. The skips

have a capacity of 20 tons of ore and travel at a speed of 2000 feet a minute. From these lower bins the ore was taken to the smelter over a steam railroad operated with three 40-ton locomotives and 22 standard steel railroad cars. The capacity of the transportation system is about 1500 tons of ore per day.

Smelter.

The smelter formerly in commission at Kennett was sold, complete, for junk in 1925 and was being wrecked at the time of visit, April, 1926. After having been shut down since May, 1919, the company had resumed operation in November, 1923, in anticipation of a continued improvement in the price of copper. These hopes were disappointed, and the last period of activity was short-lived, continuing only about a year.

This smelter had a capacity of 2200 tons and used the semi-pyritic process, using one car of coke to three of ore and silica. The excess iron in the ore was overcome by using an excess of silica and limestone, giving a thin slag. The copper matte was treated in five Allis-Chalmers converters and blister copper was shipped to the refinery at Chrome, New Jersey. Due to agitation against smelter fumes in late years, the smelter was equipped with a bag-house containing 2960 bags. There has accumulated from these bags an estimated total of 20,000 tons of flue-dust which contains copper, zinc, gold, silver, lead, antimony, cadmium and sulphur and is said to be worth over \$20 a ton. No commercially successful method of recovering the values has been found.

Bibl: Cal. State Min. Bur. R. XIV, pp. 767-769; XX, pp. 435-438. Bull. 50, pp. 95, 97.

McClure or Pioneer Group of Mines. The property is situated in Secs. 9 and 16, T. 34 N., R. 3 W., $1\frac{1}{2}$ miles north of Copper City, in the Pittsburgh mining district, and adjoins the Bully Hill Mine on the northeast. Holdings consist of the following claims: McClure, Andrews, Banner, Everett, Hope, and Poverty, totaling 160 acres; patented.

Development consists of a crosscut tunnel 500 feet in length. Owners, Mount Shasta Gold Mines Corporation.

Bibl: Cal. State Min. Bur. R. XIV, p. 769; XX, p. 438. Bull. No. 50, p. 110.

Minnie Haley Group of Mines is located on the west slope of Horse Mountain, in Sec. 24, T. 34 N., R. 4 W., $1\frac{1}{2}$ miles northeast of Heroult. Elevation is 1800-2000 feet. Owners are James Doyle and George G. Dean of Redding. Holdings consist of 8 claims.

The ore is found along epidote dikes which occur in the Dekkas andesite on the western slope of Horse Mountain. The ore is chalcopyrite associated with iron pyrite in quartz gangue, and carries values in gold and silver.

Developments consist of four tunnels from 20 to 150 feet in length. Two men employed on development work.

Bibl: Cal. State Min. Bur. R. XIX, p. 92; XX, p. 439.

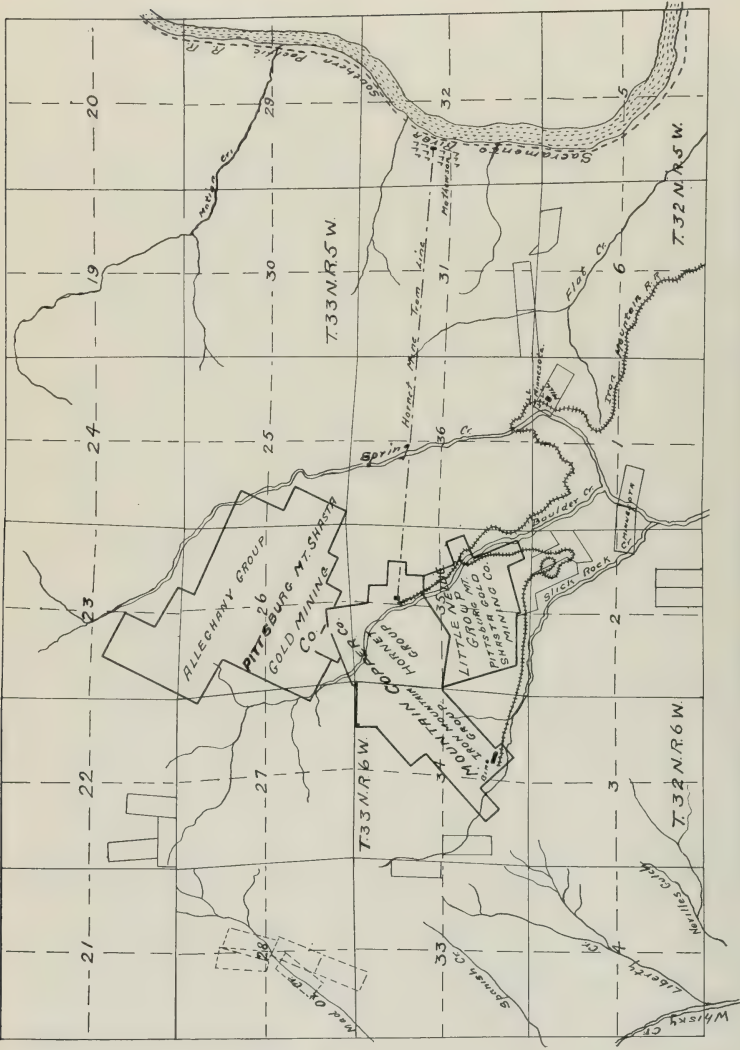
Mountain Copper Company's property includes the Iron Mountain and Hornet mines, comprising several hundred acres of patented land located in Secs. 34 and 35, T. 33 N., R. 6 W., 11 miles by railroad northwest of Keswick. Owners, Mountain Copper Company, 3 Lombard

St., London, England. Sir Charles Fielding, president; A. N. Frewer, secretary. Pacific coast office, 332 Pine St., San Francisco. W. F. Kett, general manager; M. F. Murphy, superintendent. Mine offices are at Mathewson, California.

Since the Fourteenth Report of the State Mineralogist, 1914, the Iron Mountain Mine operated until the early part of 1921, when operations were suspended, due principally to the low price of copper. In 1915, a 500-ton flotation plant was built at Minnesota Station on the Iron Mountain Railroad for the purpose of treating the low-grade ores from the Iron Mountain Mine. The Hornet Mine has been under continuous operation, producing from 400 to 500 tons of pyrite ore per day. A new crushing and sizing plant, with a capacity of 600 tons per day, was constructed and put in operation in October, 1920. In February, 1922, an aerial tramway from the Hornet Mine to Mathewson, a station on the Southern Pacific Railroad, was put in operation. It is $2\frac{1}{2}$ miles in length and has a capacity of 100 tons per hour, and replaces the old Iron Mountain Railroad, used by the company for ore shipments for many years. The company ships 500 tons of pyrite ore daily to chemical plants near San Francisco. The Keswick smelter has been dismantled and the shops removed to Mathewson.

Hornet Mine. This mine lies to the north of the Iron Mountain Mine, on Boulder Creek, where a gossan capping, with a general strike of N. 30° E. is exposed, indicating the position of an immense orebody of pyrite which has been developed by a number of tunnels. One tunnel 300 feet above Boulder Creek is 500 feet in length on the eastern edge of the orebody. A lower tunnel, a short distance above the creek, follows the greater part of its length of 1600 feet along the western border. The main haulage tunnel is 10 by 10 feet, 3000 feet in length and is 180 feet below the old adit.

The ore occurs in a large fissure along a shear zone in the rhyolite. The lens of ore developed is several hundred feet in length; width and depth are undetermined. The general strike of the orebody is N. 30° E., with a dip almost vertical. The ore is nearly pure iron pyrite with not over 1% to 2% silica, the average copper content being 0.7% and the sulphur content 45% to 48%. The ore is mined by combination of shrinkage and caving method. Estimated tonnage of ore developed is about 5,000,000 tons. Ore is hauled from the mine by electric motor in trains of ten 7-ton cars to a bin at the crushing plant which has a capacity of 700 tons. From the bin the ore passes through a No. 6 Gates gyratory breaker, and is conveyed to a 4-foot trommel over the railroad bins, where it is screened into three sizes, namely: minus $\frac{3}{8}$ -inch; plus $\frac{3}{8}$ -inch; minus $1\frac{1}{2}$ -inch; plus $1\frac{1}{2}$ -inch, which includes pieces up to 4-inch maximum. About 10% to 20% of ore coming from the mine, containing waste, is classed as second-class ore and is dumped into separate bins. This ore is fed to a 4 by 12-foot trommel having screens with $1\frac{1}{2}$ -inch openings. The oversize from the trommel goes to the picking belt conveyor, where the waste is sorted out. This waste is conveyed to the waste dump, while the clean ore goes to a No. 6 Gates gyratory crusher. The undersize from this trommel goes to the jig storage bin. From these bins the ore is fed by means of a Challenge disc-feeder to four one-compartment Harz jigs. The concentrates from these jigs flow to a special dewatering bin at the railroad. The $1\frac{1}{2}$ - to 4-inch size material is shipped to the Standard Oil Company, at San Francisco, and the



MOUNTAIN COPPER COMPANY AND ADJOINING PROPERTY
SHASTA COUNTY.

0 1000 FEET

PLATE III

mine's 3-inch material to the General Chemical Company, at San Francisco. The Standard Oil Company returns the pyrite cinder to the company's smelter at Martinez, where it is leached and the copper extracted. The Hornet Mine is the only property owned by the company that is under production. However, it is the company's plan to resume operations at Iron Mountain Mine when the price of copper will warrant reopening it. Two hundred men are employed.

Iron Mountain Mine. This mine has been operated since 1880, it being the pioneer copper mine of the Shasta copper belt. The company controls a large acreage on Iron Mountain, between Slick Rock and Boulder creeks. Elevation varies from 2400 to 3200 feet. The Iron Mountain fissure occurs in the rhyolite and has a course of N. 70° E., and dips 75° W.



Crushing and Sizing Plant, Hornet Mine, Mountain Copper Company, Keswick, Shasta County.

The ore deposits of Iron Mountain consist of immense masses of sulphides, mainly underlying a gossan capping 300 feet in width, but in places the ore occurs in and under rhyolite. The principal ore mass developed lies on the southern slope of Iron Mountain above Slick Rock Creek. This orebody was 800 feet long, from 100 to 400 feet wide, and 600 feet in depth below the gossan outcrop. It contained about 2,000,000 tons of ore of all grades. The ores are chalcopyrite associated with massive pyrite carrying from 2.5% to 5% copper, with \$2 in gold and silver per ton. The pyrite orebody has been worked out, but it is reported the present ore reserves amount to 300,000 tons of siliceous copper ore carrying 3% copper. (Plate III.)

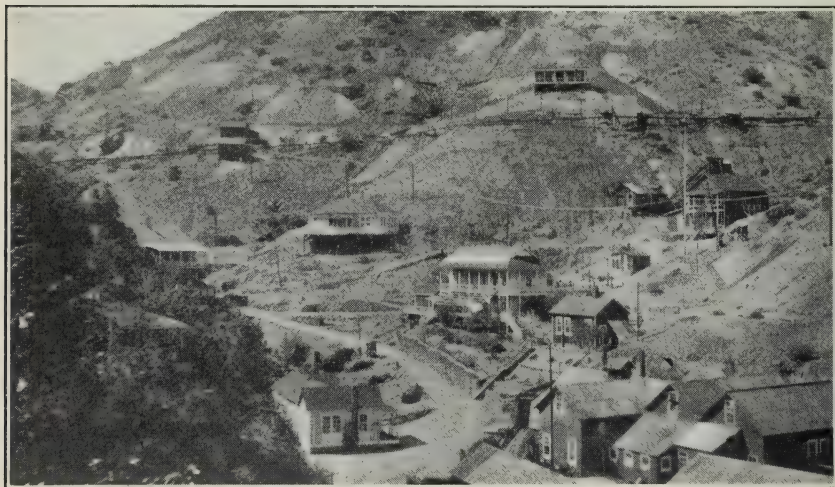
Developments consist of thousands of feet of tunnels, the principal tunnels through which the ore was mined being No. 8 mine tunnel, driven N. 10° W. 3000 feet, and at a higher elevation, the Confidence tunnel, driven N. 40° W. several thousand feet. The Complex Mine,

which is located east of Confidence tunnel at an elevation of 3150 feet, has been driven north 3000 feet, intersecting the Iron Mountain fissure. An incline tram connects this mine with bunkers on the Iron Mountain Railroad, a distance of 1500 feet.

From 1915 to 1921, the principal production from the mine has been siliceous ore running 2%, which was treated in a 500-ton flotation plant.

Flotation Plant.

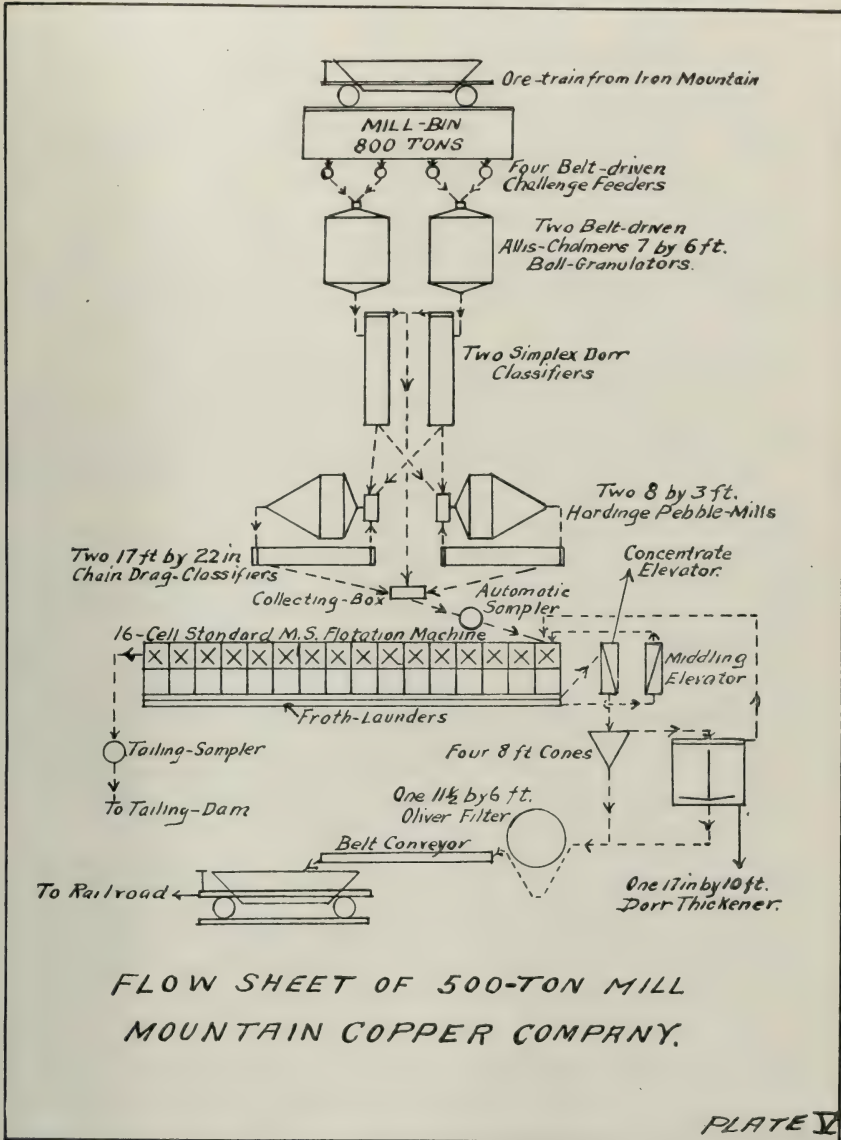
The crushing plant is at Iron Mountain Mine. The ore is delivered by electric haulage from No. 8 tunnel to the mine storage bin, which has a capacity of 1200 tons. The bin is covered with 30-lb. rails, spaced 10 inches apart. Oversized pieces are broken by sledge hammer. Ore from the bin is fed on a conveyor by six feed-gates, then to a 48-inch trommel, where it is screened to pass a $2\frac{1}{2}$ -inch ring, the oversize going to a No. 6 Gates gyratory crusher, and through-size being conveyed to the railroad storage bin which has a capacity of 700 tons. Through-size



View of the Iron Mountain Mine, Mountain Copper Company, Shasta County.

from the gyratory crusher goes to a 42-inch trommel, the oversize going to a picking belt, where high-grade chalcopryite is sorted out for shipment direct to the company's smelter at Martinez. Through-size is elevated to a distributing conveyor, which carries the ore to the railroad storage bin. The capacity of the crushing plant is 600 tons in eight hours. A 100-h.p. motor drives the plant. The ore is hauled five miles over the Iron Mountain Railroad to the concentrator at Minnesota Station. The narrow-gauge ore train consists of a Shay engine and seven cars. The ore from the bin is fed by four belt-driven Challenge ore feeders to two belt driven Allis-Chalmers 7- by 6-foot ball granulators, then to two simplex Dorr classifiers. From the Dorr classifiers, oversize goes to two 3- by 8-foot Hardinge mills, in closed circuit with two 17-foot by 22-inch chain drag classifiers. Slimes from the Dorr classifiers go to a collecting box joining slimes from chain drag classifiers. The ore is ground to pass a 60-mesh screen. From the collecting box, the material goes to a 16- by 24-inch standard Minerals Separation

flotation machine. Froth from the flotation machine is elevated to four 8-foot cones. Overflow from the cones passes to one 17-inch by 10-foot Dorr thickener. The chief object in the use of cones is to collect the coarser part of the concentrates amounting to about 75% of the whole. The coarse concentrate goes to one 1½ by 6-foot Oliver



filter. The colloidal part of the concentrate which is drawn from the Dorr thickener is filtered separately. The concentrate averages something over 10% moisture. The ore milled averages about 2% copper, with 8% iron, and the concentrate runs about 15% copper. The average recovery is 92%. Ratio of concentration is about 7:1. The production

from 500 tons of ore milled is about 70 tons of concentrate. Rated horsepower of plant is 590. (See Flow Sheet, Plate V.) Plant idle in 1926.

Bibl: Cal. State Min. Bur. R. XIV, pp. 769-770; XX, pp. 440-445.
Bull. No. 50, pp. 70-78.

Mountain Monarch consists of 120 acres in Secs. 28 and 33, T. 32 N., R. 6 W., two miles south of Stella, in the Shasta mining district. Owners, Mountain Monarch Mining Company, of Redding. The ore, principally malachite, occurs in meta-andesite, and is five feet wide on the surface. A crosscut tunnel has been driven 700 feet, exposing some ore, but the main orebody has not been reached. Idle.

Bibl: Cal. State Min. Bur. R. XIV, p. 770; XX, p. 445.

Ohio consists of 120 acres, patented, in Sec. 12, T. 33 N., R. 6 W., five miles west of Coram, in the Flat Creek mining district. Owners, Bliss Estate of New York. Several tunnels have developed some pyrite ore. Idle.

Bibl: Cal. State Min. Bur. R. XIV, p. 770; XX, p. 445.

Shasta Belmont Mine consists of 7 claims located in Sec. 24, T. 34 N., R. 4 W., on Horse Mountain, west of the Bully Hill district, and 1½ miles northeast of Heroult. Elevation 1850 feet. Owner, Shasta-Belmont Mining Company; W. E. Carson, president; J. T. Davis, secretary. Offices, Carson City, Nevada.

Developments consist of two tunnels driven east along an east-striking fracture. The lower tunnel is 350 feet in length. Fifty feet above this tunnel there is another tunnel 225 feet long. Lower and upper tunnels are connected with a raise, also with a shaft 75 feet deep from the surface. The orebody occurs along an east fracture in Dekkas andesite, and where developed was from six inches to two feet wide, showing streaks and bunches of high-grade copper ore, mainly chalcopryrite and chalcocite, with pyrite in a quartz gangue. It is stated that three cars of ore which had an average value of 7% copper and about 4 ozs. silver, were shipped to the Mammoth smelter at Kennett. Idle.

Bibl: Cal. State Min. Bur. R. XX, p. 445.

Shasta King Mine consists of 16 patented claims known as the Shasta King Group, located in Secs. 11 and 12, T. 33 N., R. 6 W., 7 miles west of Kennett, on the south fork of Squaw Creek, and adjoining the Balaklala Mine on the north. Elevation 1650 feet. Owner, Trinity Copper Corporation; T. W. Lawson, president; John N. Reynolds, secretary; Allan Arnold, treasurer. Offices, 85 Devonshire St., Boston, Mass. The company also owns the King Copper and Lost Desert groups, located between Spring and Motion creeks, in Secs. 23, 24, 25 and 26, T. 33 N., R. 6 W., their total holdings comprising 1200 acres of mineral land.

The Shasta King orebody lies on the west slope of south fork of Squaw Creek, nearly opposite the Balaklala orebody, but at a lower level. The Shasta King orebody is somewhat irregularly basin-shaped. It is several hundred feet in width, with the longer axis running nearly north and south. It is limited for the most part by fissures, along which there has been decided shearing. These fissures have a general

northerly strike. The gossan croppings are very prominent and can be followed by several hundred feet. The ore is chalcopyrite associated with iron pyrite, averaging 2% copper and 1 oz. silver, with small gold values.

Developments consist of crosscut tunnels driven from the side of the mountain at different elevations, which connect with drifts on the ore-body. The main haulage tunnel is 1145 feet in length; another tunnel, 175 feet vertically lower, is 1100 feet in length. The orebody developed in these workings is a lens of massive pyritic ore 200 feet wide and 1000 feet long, but it does not extend down to the lower tunnel level. The different levels were known as 830-, 850-, 860-, 870-, 900- and 1045-foot levels.

Total underground workings are over 15,000 feet in length. It is stated the ore reserves amount to 400,000 tons. The ore was hauled from the main haulage tunnel by electric motor to 500-ton capacity bins. A double track incline 900 feet long transports ore from the bins to the Balaklala aerial tram.

Equipment consists of Laidlaw-Dunn compressor driven by 200-h.p. motor, cars, track, blacksmith shop, ore bins, laboratory, warehouse, shops, hospital, and about 25 houses for employees.

All the holdings of Trinity Copper Co. were attached in August, 1923, by the Federal National Bank of Boston.

Bibl: Cal. State Min. Bur. R. XX, p. 445.

Shasta May Blossom Mine is located in Sec. 14, T. 34 N., R. 3 W., one mile north of Winthrop, in the Pittsburgh mining district, and comprises 26 unpatented claims known as the Keith Group. Elevation is 1250 feet. Owner, Shasta May Blossom Mining and Smelting Company; C. M. Bradley, president; E. Seaburg, secretary. Offices, 604 Mills Building, San Francisco.

The workings are located along the contact of Bully Hill rhyolite and black and gray shales, the latter being the footwall. The top of the mountain is capped with rhyolite, and on the east slope of the ridge are gossan croppings.

Development consists of two tunnels, the lower being 720 feet long. One hundred feet vertically from this tunnel is the upper tunnel 600 feet in length, with a raise to the surface. Only small lenses of ore were developed, the ore being principally iron pyrite with small amount of chalcopyrite.

Equipment consists of Rix compressor driven by a 50-h.p. motor, also blacksmith shop, compressor house, and bunkhouse. Idle.

Bibl: Cal. State Min. Bur. Bull. 50, p. 100; R. XIX, p. 91; XX, p. 446.

Shasta National Copper Company's property consists of 38 unpatented claims located in Secs. 18, 19 and 20, T. 34 N., R. 5 W., on the ridge southeast of Backbone Creek, six miles northwest of Kennett. Officers of the company are: W. H. McEwen, president; M. P. Fries, vice president; Horatio Allen, secretary. Offices, M. P. Fries & Company, 1635 Broadway, New York. The property adjoins the Mammoth Copper Company's holdings. Development consists of a number of tunnels. Idle.

Bibl: Cal. State Min. Bur. R. XX, p. 446.

Summit Group of Mines is located in Sec. 30, T. 34 N., R. 5 W., four miles northwest of Kennett, in the Backbone mining district.

The principal workings are on the eastern slope of Bohematosh Mountain, and the claims adjoin the Mammoth Company's holdings on the west. Elevation 3100 feet. Owner, *Stauffer Chemical Company* of San Francisco.

The country rock is rhyolite, which is heavily mineralized with pyrite and chalcopyrite.

Development consists of three tunnels, one 400 feet long, with a 350-foot raise.

A 4-drill Sullivan compressor, shop, ore bins, and dwellings constitute the surface equipment.

The ore was transported to the Mammoth Mine over the tram line from the Sutro Mine. Idle.

Bibl: Cal. State Min. Bur. Bull. 50, p. 97; R. XIV, p. 773; XX, p. 447.

The King Copper Group consists of 23 claims about $2\frac{1}{2}$ miles south of the Shasta King. The general trend of the orebody developed on this property is N. 70° W., dip 80° SW. The mine has about 1000 feet of development work. Idle.

Bibl: Cal. State Min. Bur. Bull. 50, p. 84; R. XX, p. 447.

Woodrow Wilson Mine is located in Sec. 4, T. 33 N., R. 2 W., $1\frac{3}{4}$ miles southwest of Ingot, in the North Cow Creek mining district. Elevation 1800 feet. Owner, Triumvate Mining Company of Ingot; H. M. Swift, president; J. H. Jones, secretary. Holdings consist of six claims, approximately 120 acres, located on the east copper belt, and adjoining the Afterthought Copper Company's property on the west. Two systems of veins have been developed, known as the Homestead and Woodrow Wilson lodes. The former occurs in a shear zone in the rhyolite, which lies south of the contact of the rhyolite and shales of the Pit formation to the north. Two shafts have been sunk on this vein to depths of 35 feet, developing 6 to 8 feet of quartz in which occur irregular lenses of ore. The ore is of a different character from that developed in the other mines of this district, in that it carries high values in lead. The quartz is mineralized with galena, chalcopyrite, pyrite and sphalerite.

The Woodrow Wilson lode lies close to the contact of rhyolite with black and gray shales, and strikes northeast, with a dip of 50 degrees to the northwest. The ore is similar to that of the Afterthought Mine, being composed largely of pyrite, sphalerite, chalcopyrite and galena, with local traces of bornite.

Developments consist of three tunnels: No. 1 tunnel, 260 feet, and 70 feet below it No. 2 tunnel, 600 feet. No. 3 tunnel is 100 feet below No. 2, and is a crosscut tunnel driven S. 70° E., 200 feet in the slate hanging wall towards the contact.

Equipment consists of cars, track, air drills, blacksmith shop, and dwellings. Idle.

Bibl: Cal. State Min. Bur. R. XX, p. 447.

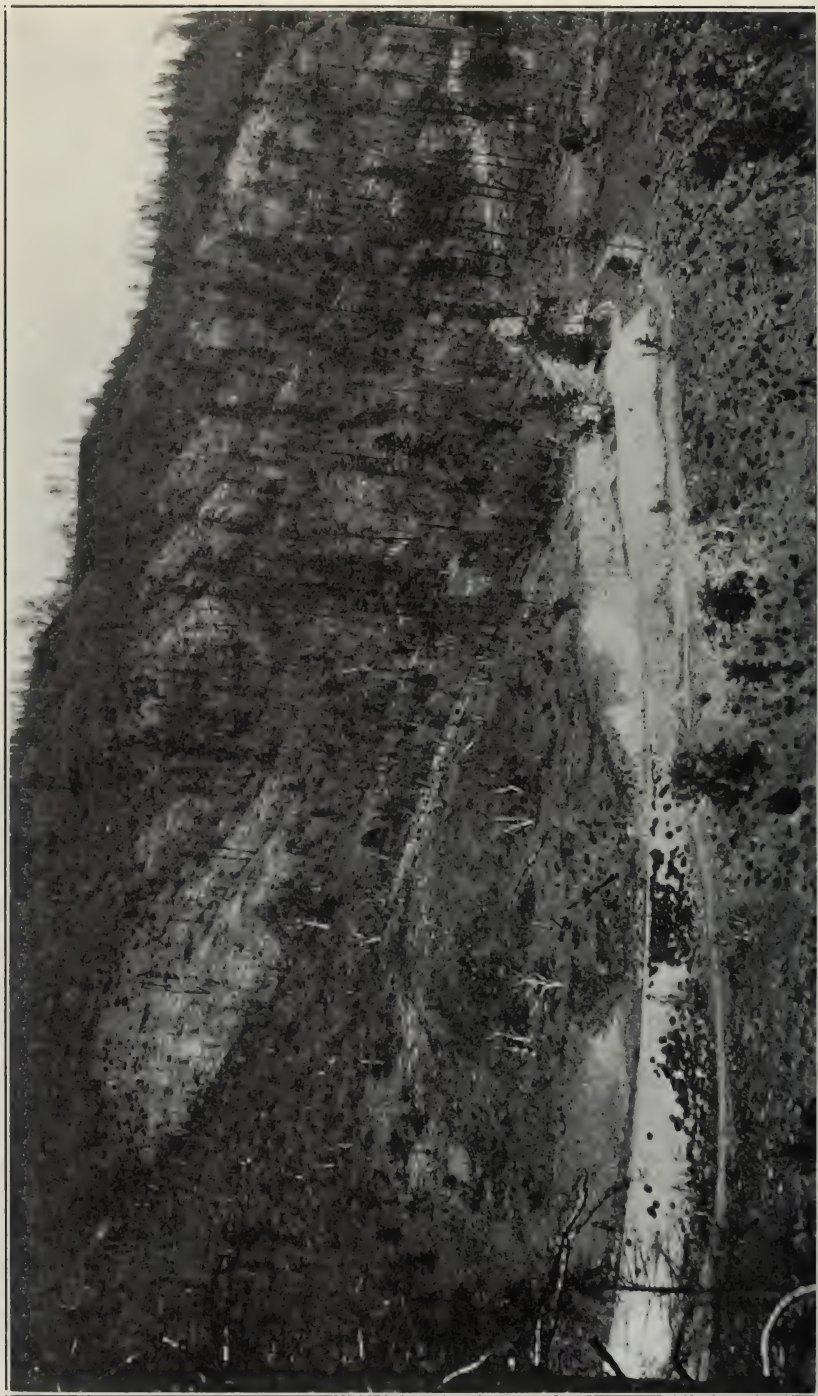
DIATOMACEOUS EARTH.

Among the largest deposits of diatomaceous earth in the state are those along Pit River from the region a few miles east of the mouth of Hat Creek on both streams, downstream to Pit 3 powerhouse. The material varies in quality as regards compactness and tint, in different localities, but there is an immense tonnage of good grade in sight. The region mentioned, in which mining claims have been located and are being held for this material, stretches for over 12 miles east and west, and four miles north and south. Not all of the land within this area is being held for mining, as parts of it had been previously alienated for farming, timber land and power purposes, although some of this land is underlain at very shallow depth by the mineral deposits. The full extent of diatomaceous earth deposits in Shasta County has never been definitely determined, and there is probably a great deal more of it than has been realized, in the eastern and northeastern sections where there was so much volcanic activity. The deposits were formed where the relatively recent volcanic flows dammed the rivers and creeks, forming lakes in which the siliceous deposits accumulated from some of the plant growth. Later volcanic flows then covered and preserved the deposits. The modern streams have cut through the lava in places, exposing the diatomite. Certain conditions will preclude the probability of development of some such areas. Among these conditions are distance from present or prospective railroads, amount of overburden on the deposits, location at or below ground water level which would mean a saturated deposit and expensive operation. Goose Valley, the region of Fall River Mills and some of the more remote lakes which were formed by lava dams, contain such deposits. A deposit of high quality also occurs 29 miles east of Anderson, in the southeastern part of the county.

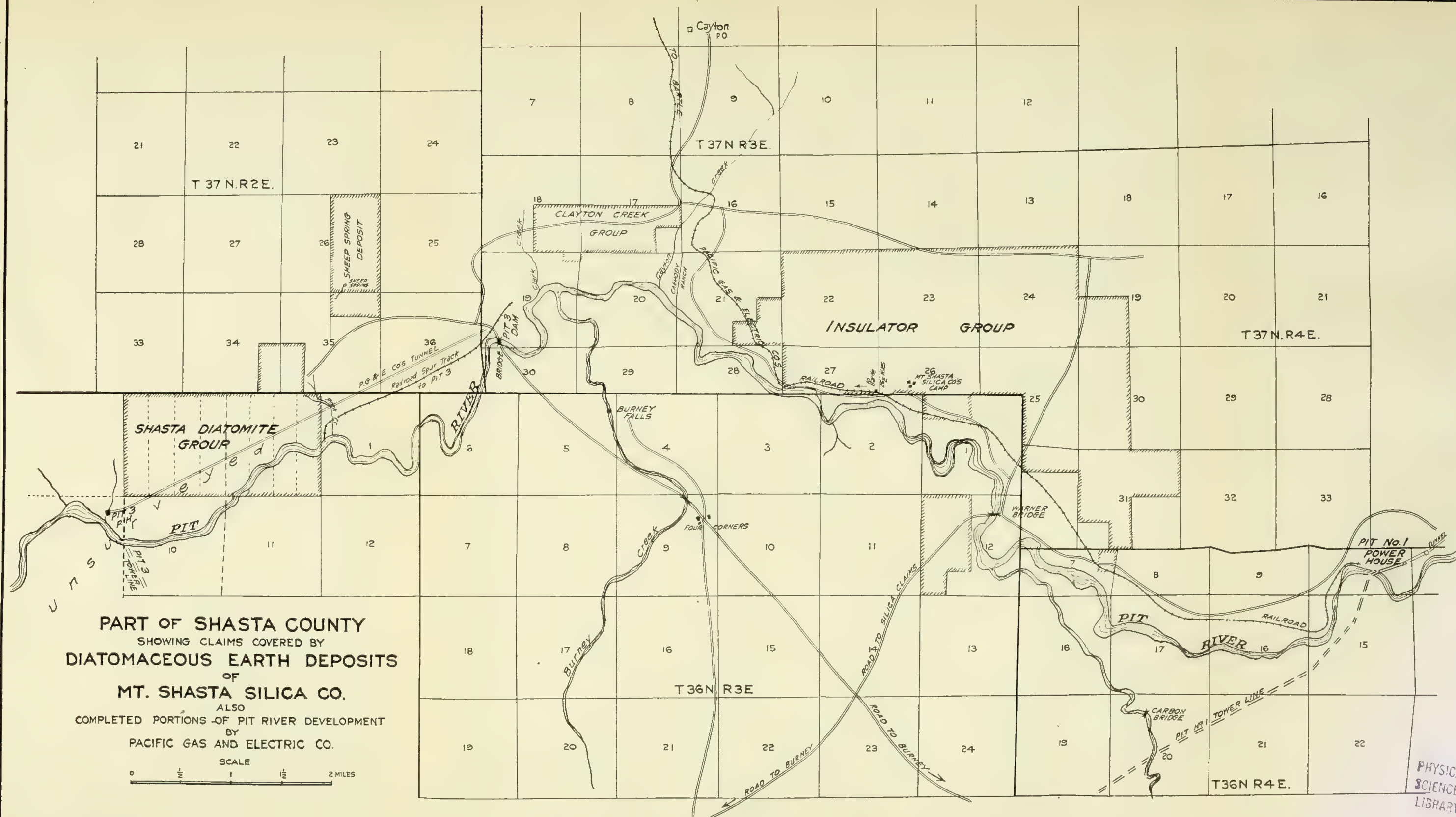
Mount Shasta Silica Company. Main office, 651 Howard Street, San Francisco. O. McCraney, president; M. H. Neimeyer, secretary and treasurer, Weed; C. O. Willis, superintendent. Holdings consist of 50 placer locations, over 7000 acres in all, along Pit River, but principally on the north side of the canyon from Sec. 33, T. 37 N., R. 2 E., to Sec. 10, T. 36 N., R. 4 E. Burney, the nearest town, is $13\frac{1}{2}$ to 20 miles by good roads from the various claims. (See map, herewith.) The claims are on or near the line of Pacific Gas & Electric Company's broad-gauge railroad from Bartle to their power houses on Pit River.

C. O. Willis, one of the locators, had known of the deposits for 20 years but they were not located until 1921 and 1922. Since then considerable assessment work has been done running adits in the deposits and building roads.

The claims are in several groups. Insulator group lies north of Pit River and is a solid block of locations, $3\frac{1}{2}$ miles wide east and west, and from $1\frac{1}{2}$ to 3 miles long. The railroad runs along the north bank of the river, 25 feet or less in places above water level, along the entire frontage of this group. The deposits extend from the river level, 2752 feet elevation, to within a short distance of the top of ridge, where the diatomaceous earth is covered by lava. According to aneroid reading it is 340 feet vertically from the railroad track to the contact of over-



Diatomite deposit on part of Insulator group of claims, Mt. Shasta Silica Company. This photo, taken from the high bluff on south side of Pit River, shows a frontage of one-half mile and an equal depth from the river to the lava contact near summit. The contact is 340 feet vertically above railroad tracks in foreground.



.....

lying lava. Diatomaceous earth outcrops for this entire vertical range, and for about one-half mile north of the river, practically without overburden, the shallow soil cover not being enough to hide the white color. The photograph taken from the lava bluff south of the river, shows about one-half mile square of deposit.

Several of the railroad cuts have been made through the deposit, and show its character. It is partly pure white, and partly flecked by faint lines and splotches of yellowish iron oxide, but this stain is so faint that the amount of impurity is manifestly very small. The banks so far as exposed show a material of uniform and homogeneous character. Only occasional "beach-lines" or false bedding planes of sand occur and these are seldom over one inch in thickness. Taken as a whole, the various openings visited show a remarkably small amount of such visible impurities, which are confined to the narrow sand seams mentioned and to infrequent narrow seams called "flint," which is perhaps partly opalized material. The deposits on this group show various degrees of density or consolidation, although as a whole probably a little denser than on other groups of claims. East of the camp, one detached deposit shows a bed sufficiently compact for sawing.

Several prospect adits and open cuts have been driven on these claims.

Since the deposition of the lava cap, erosion by the river and its small tributaries has dissected the deposit, leaving several detached bodies along the different ridges, so that a tremendous available tonnage, above water level, has been exposed by nature. The camp is about the center of this group, 13 miles by road from Burney. The material is ideally located for convenient and cheap mining and loading. At many places pits could be opened beside the tracks and the earth could be dumped directly into the cars using gravity entirely. All of these beds are within easy access of the railroad.

The diatomaceous earth continues northward under the lava cap, as shown at intervals along the road running north from Warner Bridge and that running west along the north line of the claims.

The Shasta Diatomite Group of claims covers all of two unsurveyed sections, which would be in sections 2 and 3, T. 36 N., R. 2 E., if surveyed, on the north side of the river eastward from Pit 3 powerhouse, and reaching an elevation of 2000 feet above the river. A branch of the railroad crosses the southeast corner of the group within a few hundred yards of an open pit site. Two short adits have been run here and show a very high quality of material, pure white, light and fine grained. A road was being built to these claims in April, 1926. These claims are well timbered and the outcrop is not conspicuous, differing in this respect from the Insulator Group, most of which has a sparse growth of scrub oak. This group of claims is being considered by the company for the initial productive operations, which they hope to begin during 1926.

The other deposits are called the Sheep Springs and Cayton Creek deposits. On the former occurs a very fine quality, soft and pure-white diatomite. An adit and several open pits have been opened here. On the latter, four short adits have been run. In all 32 adits have been run to prospect the different claims and several miles of road have been widened or built.

Equipment includes a tractor, auto trucks, and a small Gayco cen-

trifugal air separator for preparing samples for shipment to prospective purchasers. There is a main camp building and several smaller ones.

The power company's railroad connects with the McCloud River Railroad at Bartle, 27 miles from the Mt. Shasta Silica Co.'s camp, and it is 36 miles from Bartle to Sisson, the junction with the Southern Pacific main line. One of the principal problems before the owners of the deposits is to secure railroad freight rates which will permit them to market their product to advantage. The size and quality of deposits justifies the belief that they are to be the basis of one of the county's most important future mining enterprises, and should so materialize within a few years if properly handled and encouraged. The available tonnage appears to be so great as to make any estimates superfluous and unnecessary. According to C. O. Willis, analyses of 105 samples have shown 84% to 90% silica, with only one as low as 78%; no clay nor lime and less than 1% magnesia. Temporary freight rates have been secured and the company hopes to begin carload shipments this year. Six men were employed when visited in April, 1926.

Analyses* of samples of diatomaceous earth from various claims of Mt. Shasta Silica Company.

Location	SiO ₂	Fe ₂ O ₃	Al ₂ O ₃	CaO
Grade near Warners Bridge -----	81.39	2.18	8.32	2.27
R. R. cut near camp -----	82.09	1.65	8.09	1.15
Sec. 25, T. 2 N., R. 37 E. (Forestry Sta.) -----	91.33	0.92	2.59	0.66
Sec. 26, T. 2 N., R. 37 E. -----	90.58	0.65	1.43	0.27
Soldier Creek -----	90.28	1.26	2.52	0.15
No. 12, extreme west end -----	97.16	nil	trace	trace
Sheep Spring -----	96.02	0.62	1.03	0.12
No. A 107 -----	88.05	1.08	6.25	1.00
No. A 52 R. R. cut next camp -----	90.25	0.65	1.55	0.25

* Analyses by Smith Emery & Co., San Francisco. Furnished by courtesy of O. McCraney.

Stewart and Moore Prospect. Owners, C. W. Stewart, Anderson and W. P. Moore, Redding. Contains 80 acres, unpatented, in S $\frac{1}{2}$ of SE $\frac{1}{4}$ of Sec. 20, T. 31 N., R. 1 E., 29 miles by road east of Anderson and 23 miles from the nearest point on the Anderson and Bella Vista Railroad.

The prospect is on the west side of a ridge west of the south fork of Bear Creek, and at an elevation of 2700 feet. Two shallow prospect shafts close together show good quality, pure white diatomaceous earth with only one foot of soil overburden. Another shallow hole about 200 feet from the above also shows diatomite. The claims were located in 1925, and as the only work done so far has been one year's assessment work, a depth of only 12 feet has been reached. Nothing is known about the extent of the deposit either as regards area or depth, as the mineral does not outcrop anywhere else on the claims nor nearby and was discovered only because an old road had been cut through it. There are no other mining claims in the region, which is practically all patented and held as timber land. This section is covered by lava except where the streams have cut through. The deposit is of interest because it gives a hint of the possible occurrence of other similar deposits where the streams have been dammed up by lava flows in past ages, forming lakes in which diatomite has accumulated, only to be hidden by later lava and by soil, and not exposed to view until the streams cut new canyons.

GOLD (QUARTZ MINES).

This branch of mining in Shasta County has been quiet for several years past due in part to unfavorable conditions which have affected quartz mining generally, and in part to local conditions. The writer found little new development to record for the period between 1922 and 1926. The notes hereunder on quartz mining are therefore principally a compilation of past reports, which are included for the purpose of making the report as nearly complete as possible.

French Gulch district, adjoining Trinity County, and 20 to 25 miles west of Redding by good road, has been the most important quartz mining region in the county. Old Diggings district, two to three miles north of Keswick, has produced a great deal of ore, as have also the mines of Squaw Creek district, four to five miles west of Kennett. A number of mines have also been operated in the region beginning three miles west of Redding and extending through the Shasta and Whiskeytown districts. Only prospecting is going on in these sections now. The Dog Creek district, west of Delta, is practically deserted.

French Gulch District.

The geology of French Gulch district has been described by H. G. Ferguson in U. S. Geological Survey Bulletin 540, in which appears also a geologic sketch map, giving the areal distribution of the principal formations and the location of most of the mines. The district is the western part of the Weaverville quadrangle, for which the topographic survey was made years ago, but no folio has yet been published for the quadrangle. The mines of the Whiskeytown district are described in the same volume.

The quartz veins of French Gulch district occur principally in the carbonaceous slates of the Bragdon formation (Carboniferous) which rests upon the Copley meta-andesite. The veins lie usually in the vicinity of porphyry dikes.¹ The slate is generally crushed and sheared, but the dikes are not. Ferguson believed the vicinity of the contact became the locus of veins because it was favorable for fissuring, and that the ore deposits were genetically connected with the intrusion of the soda-granite porphyry. Quartz is the principal gangue mineral, with some calcite. Pyrite, galena, sphalerite and arsenopyrite are usually found, with galena and sphalerite predominating where slate is the wall rock. The gold is usually coarse. In many of the mines, the gold occurs concentrated into pockets or pocket shoots. A great many of these pockets have been mined by the professional pocket miners, who work usually in pairs or alone, with little outlay for equipment. Their workings are usually shallow shafts and narrow drifts, where they sink on the highest point of their gold "trace," after having followed it patiently and skillfully perhaps for weeks. Among the numerous pocket mines, a few have been worked more extensively, the Five Pines Mine in Trinity County and the Mad Mule Mine north of Whiskeytown (Schilling) in Shasta County, being the best known. The pockets occur typically near the surface and at or near the contact of the black slate and meta-andesite or diorite porphyry. Manganese oxide has been regarded as a cause of the solution of the gold which geologists believe was precipitated when the gold-bearing solution came

¹ Ferguson, H. G., Gold Lodes of Weaverville Quadrangle. U. S. Geol. Survey Bull. No. 540, pp. 22-79.

in contact with the carbon in the slate, causing the deposition of gold on the decomposed meta-andesite at or near the contact.

Quartz mining began in 1852 with the location of the Washington Mine. Gold production was greatest between 1900 and 1914. The largest producers with their estimated outputs were:

Gladstone	\$3,000,000
Washington, nearly	2,000,000
Niagara	1,000,000
Milkmaid & Franklin.....	2,500,000
American	300,000
Summit	200,000

Old Diggings and adjacent districts.

There have been several productive quartz mines in Old Diggings district, of which the principal ones were the Reed, with a reported output of \$2,500,000 and the Central, which produced about \$500,000. The Reed Mine was active up to late in 1924. The mines here and at Quartz Hill have wide veins of solid white quartz. The country rock is a series of old igneous rocks, mapped as the Copley meta-andesite, or altered andesite. West of the railroad in Squaw Creek district, the country rock is the Balaklala rhyolite ¹ in which occur so many of the important copper mines of the county. The Uncle Sam was the principal producer here.

While many of these mines have produced small and large bunches of rich ore, probably the greater part of their tonnage would be classed as low or medium grade smelting ores. Most of them were so conveniently situated that the ore could be delivered at low cost to the smelters formerly operated at Bully Hill, Keswick and Kennett. The quartz ore was in demand at the smelters for flux, and no doubt a great deal of it was utilized in this way that would have been too low grade to handle otherwise. Quartz of very low grade was worth two dollars a ton for flux, and could be mined and delivered over aerial tramways to the railroad cars at a cost which allowed some profit even if little or no credit were received for gold. The great variation in grade of ore is illustrated by the smelter returns from the Central Mine where the assay value over a period of several years for good-sized shipments, varied from \$3.40 to \$80 a ton, and averaged over \$13 a ton for five years.

While some reduction plants were formerly operated at Old Diggings it is said that only about 50% of the gold was recoverable in the free state and smelting was the best method of treatment. Small amounts of pyrite and chalcopyrite occur. The Uncle Sam Mine, on the other hand, operated for many years with a 20-stamp mill, concentrators and a chlorination plant and is said to have produced over \$1,000,000. In later years the mines depended entirely on the smelters to handle their ores, and as three smelters formerly active are dismantled, there is no activity in these districts now, although there remains unworked considerable ore of a grade similar to that already mined.

Whiskeytown and Shasta Districts.

In Whiskeytown district, which is west of French Gulch, only a little development work is going on, although at one time the district had several small gold quartz producers. Whiskeytown (Schilling P. O.)

¹ U. S. Geol. Survey Folio No. 138, Redding Folio.

is on the Trinity lateral of the state highway system, and the mines are 12 to 15 miles west of Redding.

The mines are mostly along the edge of a mass of alaskite porphyry and developments for the most part have been by shallow adits and shafts a few hundred feet deep. Numerous pocket mines have been worked. Milling ore is often lower grade and more complex than in French Gulch district, although a great deal of quartz in the eroded surface material and in numerous outcropping veins shows little sulphide. A striking feature is the great number of shallow workings to be seen. The large mass of alaskite-porphyry extends north from here, and the Iron Mountain, Balaklala and other copper mines are in it only a few miles away. Whiskeytown district has in late years been producing from a few hundred to \$15,000 in gold per annum, depending on the success of the pocket hunters who make most of the production.

Many claims are being held, but little work is being done in Shasta district. The mines are in granodiorite, alaskite-porphyry and quartz diorite, east and southeast of the Whiskeytown district. The region was formerly famous for its placers, which have been worked out. The few pocket miners are the only producers at present. The Bonanza Gold Dollar Mine (now called Shasta View) made a little production several years ago with a 5-stamp mill, and promises to become active again. The principal producer was the Mt. Shasta Mine, adjacent to the Shasta View. The Mt. Shasta produced about \$180,000 to a depth of 465 feet from ore said to have averaged \$42.69 a ton. It has been idle for yeears and the plant has been burned down.

American Mine is in Secs. 12 and 13, T. 33 N., R. 7 W., on the ridge north of Cline Gulch, $3\frac{1}{2}$ miles northeast of French Gulch at an elevation of 2800 feet. Owner, W. Frank, French Gulch.

It was located in 1887 and \$2,000 was said to have been taken out with a hand mortar, after which tunnels were driven at different elevations between 2500 and 3150 feet and a 10-stamp water-power mill was erected. The estimated production was \$300,000. The property contains 100 acres, of which 60 acres are patented.

The vein strikes N. 80° E. and dips 80° S. to vertically. Four adits, from 50 to 1400 feet long, were run. An ore shoot 125 feet long and 2 feet wide was stoped to a height of 240 feet. A depth of 650 feet was reached. Operations ceased about 1908. In 1923 a Nevada company did some work, but is not known to have made any production. In April, 1926, Art Brown, A. Fondahn and Nelson Wheeler took a lease and a bond on the mine and were moving a compressor to it preparatory to beginning work.

Bibl: Cal. State Min. Bur. R. VIII, pp. 564-565; X, p. 637; XII, p. 245; XIII, pp. 349, 357; XIV, p. 778; XIX, p. 135; XX, p. 15. U. S. G. S. Bull. 540, pp. 35, 60-61.

Bell Cow Mine, formerly known as *Arbuckle Mine*, is situated on the southwest slope of Arbuckle Mountain, in Secs. 35 and 36, T. 30 N., R. 9 W., 18 miles southwest of Ono. Owners: J. W. Carter, J. P. Erhart, Frank A. Greene, S. H. Fisk and Herbert Fisk of Redding.

Holdings consist of 16 claims, comprising 332 acres. On the property, there is a series of parallel siliceous dikes, the most prominent being west of No. 2 tunnel workings. The general trend of the main veins is

northwest, and dip from 30 to 40 degrees westerly, toward a massive siliceous dike which is schistose in structure. This dike is 6 to 10 feet in width and extends over the full length of the Bell Cow No. 1 claim and into adjacent claims.

The different veins have been developed by 9 adits, at different elevations on the slope of the ridge south of the Middle Fork of Cottonwood Creek. At an elevation of 1800 feet, No. 1 tunnel is a crosscut driven 500 feet to cut vein opened up in No. 2 tunnel. About 50 feet above No. 1 is No. 2 tunnel, driven 203 feet on the main vein. In this tunnel a vein of quartz was developed from 2 to 4 feet in width. Reported to assay from \$10 to \$20 per ton. The shoot is 200 feet long. No. 3 tunnel is a crosscut tunnel, driven 165 feet to cut the same vein, and southeast of this tunnel is No. 4 tunnel, 75 feet in length to the vein. The other tunnels are caved, but reported to be from 20 to 150 feet in length. Total lineal feet of drifts and crosscuts is 1273 feet.

There is a 5-stamp mill on the property, 1050-pound stamps, 7" by 9" Dodge crusher, Challenge ore feeder, amalgamating plates, Woodbury concentrator, all driven by 15-h.p. Fairbanks Morse gas engine. Idle.

Bibl: Cal. State Min. Bur. R. XVIII, p. 493.

Central Mine. Owners, A. A. Anthony, 615 Pine Street, Redding, two-thirds; W. T. Thompson and J. W. Holbrook, one-third. There are five patented claims, containing 60 acres in all, in Sec. 4, T. 32 N., R. 5 W., in Old Diggings district, 11 miles by road north of Redding.

There are four veins on the property, three of which strike north and dip 65° east and the fourth strikes east. Work has been confined to the north-striking Central vein, which has been mined through adits. The lowest of these is the only one now accessible. It is a crosscut to the west for 956 feet, where it cut the vein and thence followed it north about 650 feet and also followed it southward until it pinched. This level gave about 335 feet of backs, and known ore above it has been stoped. One stope in the north drift was 150 feet long, 30 feet high and 10 to 15 feet wide. There was six feet of solid quartz on the foot-wall, the balance of vein being a stringer lead. The country rock is altered andesite. On the south, about 400 feet of work failed to develop ore. On this side, the vein pinched down to nothing.

This adit was run from about the center of Central Extension claim, through the Central claim to within 400 feet of the north end-line. About 300 feet west, on the Shasta claim, is the parallel Shasta vein, and the Pocket vein, also striking north, lies 250 to 300 feet east of the Central. The east-striking vein crosses the north end of claims, 300 to 400 feet north of the present face of Central adit, depending on dip of east-striking vein, which at the surface is about 45° north.

In the earlier work between 1885 and 1895 Huntington mills were used for crushing ore, the millsite being on the river some distance from the mine. It was found that only about 50% of the gold was recovered by this method. Later, shipments to Selby smelter, Keswick smelter and finally to Kennett were made. The total output is estimated at about \$500,000, but smelter receipts for much of this have been lost. Receipts in Anthony's possession for shipments to the Keswick smelter between 1900 and 1906 show assay values ranging from \$3.40 to \$84 a ton, little of the ore going below \$6 a ton, and the average for six years being over \$13 a ton. Of course, much lower grade ore

was shipped later, as it could be cheaply worked and delivered, and the quartz was worth \$2 a ton as flux alone. A tramway delivered ore from the mine to railroad.

The lower part of this mine could be prospected to advantage from the Reid Mine shaft, which is nearby. There is no equipment at the Central.

Bibl: Cal. State Min. Bur. R. VIII, p. 565; X, p. 631; XII, p. 246; XIII, p. 351; XIV, p. 782; XVIII, p. 494.

El Dorado Mine. The property is situated one-fourth of a mile southwest of Tower House, in Sec. 3, T. 32 N., R. 7 W., in the French Gulch Mining District. Holdings consist of 40 acres of patented land. The mine is owned by James G. Conner of Redding; under lease to Messrs. Statton and Van Slyke of French Gulch. Discovered in 1885. Worked for seven years, 1912 to 1919. The workings are on the steep slope of a ridge north of Mill Creek at an elevation of 1500 feet. The lode lies along a fault contact of meta-andesite and black slate, striking N. 20° W. and dipping 35° east. Along the slate hanging wall, quartz occurs in lenses up to 2 feet in width. Occasionally the quartz is found in the meta-andesite close to the contact and usually mixed with fragments of andesite. Manganese stains are quite common in the quartz, which is oxidized.

Ore is mostly free milling, but some pyrite is associated with it. Numerous fine specimens showing free gold through the quartz have been taken out. Development work consists of a main adit tunnel, 450 feet long, driven northwest on the lode. At 250 feet from the portal of the tunnel, a winze has been sunk, on the vein 50 feet, with a drift north on the vein 26 feet. Here the vein varies from 2 to 3 feet in width. At the face of the drift the vein is cut off by a fault.

At 340 feet from the mouth of the tunnel there is an upraise 30 feet in ore. It is stoped out here for a length of 50 feet to top of raise, then the vein flattens and values disappear. It is reported that \$4,000 was taken out of this raise. The gold occurs entirely in pockets in the quartz. Equipment: Blacksmith shop, tools, and bunkhouse and a two-stamp mill (850-lb. stamps) with triple discharge mortar and amalgamation plates, operated by 8-h.p. Fairbanks Morse Gas Engine. Two men employed.

Bibl: Cal. State Min. Bur. R. XII, p. 247; XIII, p. 355; XVIII, p. 406.

Ganim Mine is situated in Secs. 5, 8, and 15, T. 32 N., R. 6 W., $2\frac{1}{2}$ miles northwest of Whiskeytown. Elevation is 1400 feet. Holdings consist of 14 claims, owned by the Ganim Mining Company, San Francisco. J. S. Ganim, president, Redding.

The country rock is meta-andesite with intrusions of alaskite porphyry. Two vein systems have been developed on the property, one showing pyrite ore, occurring in a shear zone, which strikes northwest and southeast and dips 25 degrees north. The country rock at a distance from the ore is a much sheared and epidotized meta-andesite in places slightly pyritized along joint planes. The lower workings on the property are not far from a contact of meta-andesite, quartz-diorite and dikes of alaskite porphyry which cut the meta-andesite in the vicinity of the tunnels. The ore where exposed near these workings is

entirely pyrite. Besides the pyrite, the only other metallic minerals are rare specks of chalcopyrite, distributed irregularly throughout the ore. Other specimens of ore consist of meta-andesite in part replaced by pyrite. Developments consist of a number of crosscut tunnels which cut this shear zone at different places. These tunnels are from 50 to 400 feet in length. The ore developed has a width of 12 to 15 feet and is reported to carry values in silver. At higher elevation, a vein of quartz 4 feet in width has been developed. Strike of vein is N. 35° W., dip vertical.

At an elevation of 1800 feet, a crosscut tunnel has been driven N. 40° E., 120 feet to the vein, with a drift northwest 100 feet on the vein. The ore is white quartz carrying copper sulphides, bornite and chalcopyrite. Reported to carry \$15 per ton in gold. This vein is developed by three other tunnels, and two shallow shafts.

A new lower adit is being driven at present to prospect at greater depth. About 425 feet from the portal in an easterly direction, drifts were turned and at time of visit attention had temporarily been diverted to a body of good grade tale which was encountered in both drifts. The tale strikes about N. 30° W. (See under Tale, herein.) Some galena has also been found lately.

Four men are employed, and several carloads of tale have been shipped. Equipment includes 9" by 14" compressor, air drills, drill sharpener, shop, 30-h.p. oil engine, 10-stamp Straub mill, one concentrator, mill building and small electric light plant.

Bibl: Cal. State Min. Bur. R. XVIII, pp. 730-731.

Gladstone Mine is in Secs. 1, 7, 8, 12 and 18, T. 33 N., Rs. 6 and 7 W., about 4½ miles northeast of French Gulch, containing 178 acres patented and formerly also 485 acres of unpatented claims.

It was discovered in 1896 and purchased by Hazel Gold Mining Company in 1901. They operated until 1915. The total production was over \$3,000,000 and locally reported as high as \$5,000,000.

The vein occurs in the slate, sandstone and conglomerate of the Bragdon formation, in a crushed zone 60 feet wide. It formed as branching stringers in the slate, or on the footwall side of the fissure, requiring the mining of considerable waste. The ore is white quartz, carrying less than one per cent of galena, zincblende, pyrite and arsenopyrite besides free gold, which carried 94% of the value. The vein strikes east, dips vertically for 1000 feet, changing to 60° south, then to north.

The upper part of mine to a depth of 1000 feet was worked through adits, from the lowest of which a shaft was sunk 1400 feet, with levels about 100 feet apart. Three separate ore shoots were worked in the upper levels; these united, and below the seventh level one was stoped. It is said that 1000 feet of drift was run to reach the shoot on 1300 level, but as the property was idle when the district was last visited, definite details were not obtained. The Ohio adit level was run 2000 feet.

In August, 1921, French Gulch Mining Company, of which Fred Searles of San Francisco was president and Wm. Simkins, secretary, took a lease on the property. The workings above the 300-level were unwatered and retimbered and a little rock was crushed, but work ceased in June, 1922, due to failure to develop new orebodies. The

company produced about \$20,000. In November, 1924, Harry Thompson of French Gulch began some work on the surface.

While under operation by Hazel Gold Mining Company the Gladstone was one of the two principal quartz gold producers of the county and was well equipped. Mine equipment included large double-drum hoist, compressor plant, electric power line nine miles long, electric locomotives for hauling ore, and shops. There was a 30-stamp mill (1050-lb stamps), with concentrators. The milling capacity was 100 tons a day and the average recovery must have been about \$10 a ton during the later years of operation.

Bibl: Cal. State Min. Bur. R. VIII, pp. 568-569; X, p. 637; XI, p. 45; XII, pp. 248-249; XIII, p. 357; XIV, pp. 787-788; XVIII, pp. 43, 96, 256. U. S. Geol. Survey Bull. 540, pp. 57-60.

Gold Bar Mines. This property comprises four unpatented claims, known as: Gold Bar No. 1, Gold Bar No. 2, Gold Bar No. 3, and Gold Bar No. 4, located in Secs. 22 and 26, T. 33 N., R. 5 W., 10 miles north of Redding, in the Churn Creek Mining district. Elevation 1600 feet. Owners are Frank O. Hollingsworth and Dr. G. A. Grotefend of Redding. The mine has not been worked since 1891, when ore was mined and hauled to the National Mill, where it is reported to have milled \$50 per ton. The property has been idle since that time, and was relocated in January, 1923. A vein of quartz four feet wide occurs in the meta-andesite, general course N. 30° W. and dip 55 degrees to the southwest. The outcrop of the vein can be traced for 6000 feet.

Developments consist of three tunnels driven on the course of the vein. The two lower tunnels are caved, but from the indications ore was stoped from the lower tunnel to the upper tunnel. The vein has been drifted on in the upper tunnel for 100 feet, developing an ore shoot 80 feet in length, and 4 feet in width. Samples taken from this vein are reported to assay from \$10 to \$15 per ton in gold. A raise from the intermediate tunnel connects with this tunnel, distance 30 feet. The present locators had two men employed cleaning out old workings in 1923, and were planning to drive a tunnel on the vein at a lower elevation. Idle in 1926.

Bibl: Cal. State Min. Bur. R. XIX, p. 93.

Harrison Gulch Mines. (*Midas, Victor and Twinvict Groups.*) Sold in part to State of California July 1, 1925, for five years taxes. Reported leased in 1926 to L. E. Lee, San Francisco. This consolidation includes the well known Midas Mine, the principal producer of the Harrison Gulch district, in Secs. 3, 4 and 10, T. 29 N., R. 10 W., in the southwestern corner of the county, 52 miles from Redding. The total acreage is about 2000 acres of mining ground, with which the last company also held 1400 acres of timber land, partly in Trinity County. The Midas Mine comprised 550 acres, and is the nucleus of the holdings, there having been little development on the other claims. The following notes are from previous published and unpublished reports, and the property was not visited by the writer.

The Midas Mine was discovered in 1894 by L. Benton and sold soon after to Midas Gold Mining Company, who operated it continuously from 1896 to April, 1914, when a fire occurred underground. During this period, the reported production was \$3,563,587 from a total of

166,632 tons, or an average recovery of \$21.38 per ton. Percentage of recovery was 76.83% and total operating cost was \$9.15 a ton.

There are three veins, called Baldwin, Middle and Gold Hill veins, the first and last named being 400 feet apart and the Middle vein between them. They average 14 to 20 inches in width, strike north of west, and dip 50° to 75° southwest.

While the district has never been studied in detail nor mapped geologically, and the deeper mine workings have not been accessible for 12 years, the country rock of the immediate vicinity is reported to be diabase, covered in places by conglomerate. The veins are said to strike with the schistosity of the country rock, but dip at about right angles to the schistosity, and the wall rock has been so altered as to have the appearance of slate. This schistose zone varies in width. The quartz occurs in lenses which carry ore shoots of good grade, while elsewhere in the fissure there is little pay. The outcrop is in places only a seam.

The Baldwin vein was mined through a double-compartment shaft 1500 feet deep with 14 levels, over 26,000 feet of drifts and 11,000 feet of crosscuts and raises. Another shaft was sunk 600 feet on the Gold Hill vein and was connected with Baldwin shaft. A prominent fault striking N. 52° E. and dipping 60° southeast cut off both veins on the 1200 level. The old company is said to have followed the fault plane from the Baldwin to the Gold Hill vein, a distance of 435 feet, and 50 feet beyond, without picking up the faulted segments.

According to Roy Leach, mining engineer formerly employed at the mine, there is ore to the value of \$150,000 blocked out in the lower levels, besides which there are ore possibilities on the Gold Hill vein in the Victor ground, and on the same vein beyond a fault. There are also two large veins which have been sampled only on top and found to be low grade, but have not been prospected at depth.

The equipment under the Midas Gold Mining Company included a 20-stamp mill, cyanide plant, 600-h.p. steam plant, steam hoists and complete surface plant, with some water power available during five months of the year.

After this company quit, the Victor Power and Mining Company took the property about 1915. They operated the cyanide plant on the stored tailings, until these were gone, milled some of the material on the waste dumps and some old fills from the upper levels. The old mill and cyanide plant were finally dismantled and two 30-ton Gibson mills were installed. They never succeeded in unwatering the mine below the 900 level, but ran the water level drift on the Baldwin vein an additional 1400 feet west in search of new ore-shoots. They quit about 1920. M. G. Henry plans a resumption of work soon, a few men having been taken to the property in March, 1926.

On the adjoining Victor property, now consolidated with the Midas, an inclined shaft 450 feet deep was sunk and three levels opened below the adit level. Only a little ore was milled in the 3-stamp Nissen mill. The vein was generally small and was lost west of the shaft. The veins in the Victor are supposed to be the same as in the Midas.

Bibl: Cal. State Min. Bur. R. XIV, pp. 792, 803.

Index Group of Mines. Located in Sec. 6, T. 32 N., R. 6 W., one-half mile north of Oak Bottom, in the Stella Mining District. Elevation

1500 feet. Owners, I. F. Rice and A. Kaleel of Whiskeytown. Holdings consist of 12 claims located on a ridge north of Clear Creek.

A series of parallel quartz veins occur in alaskite-porphry intrusions in meta-andesite. The veins have a general east and west trend, with dips north. Widths vary from 2 inches to 6 feet. Developments consist of two tunnels, one 140 feet in length and the other 150 feet, and a number of shallow prospect holes and open cuts. There are three men employed on assessment work.

Bibl: Cal. State Min. Bur. R. XIX, p. 57.

Mad Mule Mine (one time called *Banghart*). It is five miles due north of Whiskeytown (Schilling P. O.), on Mad Mule Gulch, a branch of Whiskey Creek. This gulch was mined by placering in the early days, but more recently by numerous adits. M. T. Thomsen, 308 Laurel Street, Alameda, is owner. The mine has been worked by different pocket hunters in late years. The gulch is about one mile long.

The pockets in the mine have been found near a diorite porphyry dike which is as much as 150 feet wide and cuts the slate, alaskite porphyry and other rocks. The ore is mostly calcite in small lenses found on both walls, but said to be richer on the hangingwall. The lenses occur in troughs or along arches on the hangingwall or footwall respectively, and are said to be only a few inches thick, three or four feet long and sometimes 20 feet high.

This mine has been the largest producer of its class in the region. In the winter of 1922-23, a pocket was found which is believed to have produced between \$7,000 and \$8,000, one piece having yielded \$4,138. This was taken out by two miners who had been permitted to prospect the mine and "keep whatever they could find." Two other men are said to have taken out about \$2,500 the same season. Work was going on in 1926.

Bibl: Cal. State Min. Bur. R. IX, p. 38; XI, p. 396; XII, p. 252; XIII, p. 361; XIV, p. 791. U. S. Geol. Survey Bull. No. 540, pp. 40, 42, 52-54.

Milkmaid and Franklin Mines. They are situated on the north side of French Gulch, in Sec. 17, T. 33 N., R. 7 W., 3 miles northwest of the town of French Gulch. Owner, Western Exploration Co.

Holdings consist of eight claims known as: Franklin, Milkmaid, Summit, Ibex, Buckeye, Virginia, Peggy and May-Day; totaling 150 acres. The Franklin mine is reported to have been located in 1852, and the Milkmaid shortly afterwards. Total production of the two mines is reported to be \$2,500,000 and from 1910 to 1922, the production was \$496,000. Most of the development work is confined to the Franklin and Milkmaid claims.

Franklin workings: Two veins have been followed to some extent in the Franklin workings; one with a strike of N. 5°-30° W., and a steep dip to the east, the other with a strike of approximately E. and W. and a dip of about 70° N.

The wall rocks are slate and soda-granite porphyry. The veins are near the contact and cut both rocks, but tend to be best developed in the porphyry, fingering out in the slates.

The Franklin is developed by two adit levels, at elevations of 1950 and 2055 feet.

The Franklin or upper tunnel, driven N. 60° E., in porphyry, at 200 feet from the portal cuts the north and south vein, which dips 60° east. This vein above the tunnel level flattens to 45° and when within 30 feet of the surface, straightens up to 70°. Width of vein varies from 12 inches to 4 feet. The elevation of the Geiser tunnel is 1950 feet. It is a crosseut tunnel driven N. 60° E., following a fault fracture, and cuts the north and south vein at 450 feet from the portal. On this level the vein has been followed for a distance of 700 feet.

The Milkmaid workings: The Milkmaid joins the Franklin on the east. The rocks in the vicinity consist of soda-granite porphyry, diorite porphyry and slate. Both porphyries are intrusions in the slate. At an elevation of 1900 feet, the lower Milkmaid tunnel is a crosseut 220 feet to the vein, and is driven 50 feet beyond the vein, a total distance of 270 feet.

The vein strikes N. 10° W., and dips 80° east. On No. 1 level, the vein is drifted on, 150 feet north and 55 feet south.

The upper Milkmaid tunnel is a crosseut tunnel, 100 feet to the vein, with drifts 150 feet north on the vein and 25 feet south. On No. 2 level, the shaft level, drifts extend 300 feet south on the vein from the shaft and 100 feet north. About 200 feet north of the crosseut tunnel an incline shaft has been sunk to a depth of 200 feet. On No. 3 level there is a drift 150 feet south on the vein from shaft. No. 1 level is 50 feet below the upper tunnel level; No. 1 to No. 2 level is 100 feet, and No. 2 to No. 3 level is 70 feet. In these workings, the vein varies from a few inches up to 4 feet of quartz; above the upper workings on the Milkmaid and Franklin veins, extremely rich oxidized ore was taken out. The gangue minerals of the vein are quartz and calcite. Much of the quartz presents a faintly mottled grayish appearance due to enclosed wall rock. The sulphides in the ore are arsenopyrite, pyrite, galena and sphalerite. The sulphides amount to about 0.75 per cent of the weight of the ore, and carry \$150 in gold to the ton. The ore in the main vein runs from \$20 to \$45 per ton and is in irregular pay shoots that probably pitch steeply to the south. The best ore is found where the vein is in the porphyry close to the slate contact.

Mine equipment: Consists of compressor plant, blacksmith shop, and bunk houses.

Reduction equipment: Consists of 10-stamp mill (1100-lb. stamps) and 4 Frue vanners, driven by electricity.

The property was under lease and bond during 1922 and 1923 to Captain H. E. Smith of Shasta, and work was carried on with a crew of ten men with Roy Leach as superintendent. The 10-stamp mill was operated on ore from the old dumps.

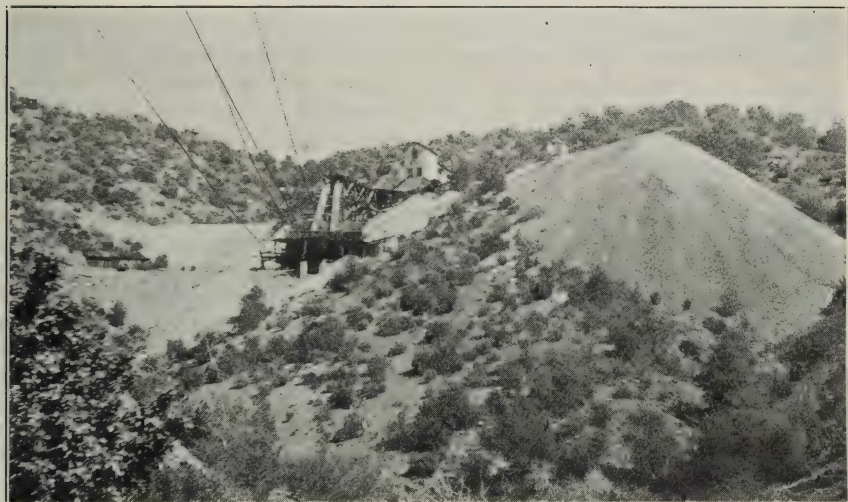
About January, 1925, E. E. Erick and associates began work and at present (April, 1926) the 10-stamp mill is in operation. The Milkmaid has been prospected, and plans for new work at the Franklin are reported.

Bibl: Cal. State Min. Bur. R. XIV, pp. 793, 794; Mining in Calif. Sept., 1922 (R. XVIII), pp. 406-409. U. S. Geol. Surv. Bull. 540, pp. 35, 61, 63, 64.

Reid Mine. It is situated eight miles north of Redding, in Sec. 3, T. 32 N., R. 5 W., in Old Diggings Mining District; elevation, 1700 feet. Holdings consist of 160 acres; a patented quarter-section.

There are several parallel auriferous quartz veins, striking almost due north, with steep dips to the east, in meta-andesite. The veins are large, varying from 6 to 30 feet in width, and very persistent. Gold values vary from \$4 to \$30 per ton. Development in recent years has been confined to the main vein. This has been opened on five levels, greatest length of pay chute was 400 feet; and maximum width 30 feet. Workings consist of 1100-foot vertical shaft, and main adit about 1000 feet long. This cut the shaft at the 300 foot level. Levels at 100 feet intervals below main adit. Ore shoot cut on 6th, 7th, 8th, and 9th levels. Stopped above the 8th level, but virgin ground below. On the 7th level, the vein was 16 feet wide, and on the 8th level, 30 feet wide, and said to have averaged \$12 per ton in gold. Quartz is very pure, containing some tellurides, and sulphides of copper.

The property was operated continuously from 1904 to October, 1919,



Reid Mine in Old Diggings District.

shipping all ore to the Mammoth Copper Company at Kennett, who used it for flux in smelting copper ores.

Equipment: Electric hoist, double drum for two compartment shaft; two 75-h.p. and one 50-h.p. motors driving 3 pairs of Ingersoll-Rand compressors, total capacity 1200 cu. ft. of air per minute; complete machine and blacksmith shop, cars and tools; and aerial tramway 4400 feet long to bunkers at railroad on west side of Sacramento River.

In 1922, the property resumed operation to furnish quartz to the Shasta Zinc & Copper Company's smelter at Bully Hill, which, however, operated only a short time. The mine was also active during the last operation of the Kennett smelter, which has been shut down about one year. Since the smelter shut down, the mine has remained idle, and at present, April, 1926, is slowly filling with water.

The Reid shaft has been suggested as the best place from which to start work to explore the Central, Evening Star and other nearby claims at depth. Several veins which have been productive in their upper levels could be prospected by crosseuts from the lower workings

of the Reid, at points several hundred feet deeper than any previous workings upon these veins.

The property has been owned by the Reid Mining Company and was managed for years by Harvey Sallee. It was the principal producer of the district for many years, employing 80 to 100 men and producing 160 tons a day. Locally, the mine is reported to have produced about \$2,500,000. In April, 1926, it was sold under trust deed to the McCormick Saeltzer Company and Redding National Bank of Redding and Capital National Bank of Sacramento.

Bibl: Cal. State Min. Bur. R. XIV, p. 797; XVIII, p. 408.

Sybel Mine. (Accident.) It is situated five miles northwest of French Gulch, in Sec. 7, T. 33 N., R. 7 W., in the French Gulch Mining District, on ridge between the North and South Forks of French Gulch.

Holdings consist of four patented claims which include millsite; total area is 80 acres. The property is owned by the Shasta Hills Mining Company, of San Francisco. Under lease and bond in 1922 to Harry Thompson and associates of San Francisco, who also controlled the Niagara group of mines, having under control 56 claims, and 520 acres of timber.

Operations were started on the Sybel mine in September, 1921, and the property was under continuous operation to May 1, 1923. It lies at the north edge of the complex of dikes which marks the position of the group of mines near the head of French Gulch. Soda-granite porphyry similar to that of the Franklin, and diorite porphyry, cut the slate. The ore for the most part lies in the diorite porphyry near contact of the slate, but in places the workings follow the contact itself, which here strikes about N. 80° W., and dips about 50° north. The ore consists of blue-gray quartz with patches and streaks of white calcite. The quartz has a mottled gray color, but the calcite is milky white and cut by veinlets of quartz and arsenopyrite. The metallic minerals are pyrite, galena, sphalerite, and arsenopyrite. Gold, wherever in plates large enough to be visible, is as a rule close to the small patches of galena. The galena and sphalerite in the quartz indicates the occurrence of rich ore. The ore being stoped carries values from \$10 to \$200 per ton, and the average mill feed runs about \$40 per ton.

Development: At an elevation of 3700 feet, a tunnel has been driven S. 75° E., 700 feet, and a winze has been sunk on the vein from this level to a depth of 150 feet; at 80 feet below adit tunnel, a drift has been run from the winze on the vein 175 feet east, and 175 feet west, developing a shoot of ore 350 feet in length. The vein varies from 12 inches to 4 feet in width. The adit tunnel is 400 feet below the outcrop of the vein. The adit tunnel cut a fault which strikes N. 50° W., and dips north 50°. The later workings on the tunnel level and in the winze are confined to the vein east of this fault, while old workings above this tunnel level were to the west of the fault. The vein strikes N. 80° W., and dips 50° north.

Mine equipment: Laidlaw - Dunn - Gordon 12" x 12" compressor, driven by 50-h.p. motor; air drills, blacksmith shop, and cars. There is a new 5-stamp mill on the property, 1000-pound stamps, and one vanner, driven by electric power, furnished by Pacific Gas and Electric Company.

The mine and mill were operated continuously during 1922, under the management of Harry Thompson, and the reported monthly production was \$6,000 to \$8,000 during part of the year. Operation ceased late in the spring of 1923, since when the mine has been idle.

Bibl: Cal. State Min. Bur. R. XIV, p. 777; Mining in Calif., 1922 (R. XVIII), pp. 43, 138, 296, 408. U. S. Geol. Survey Bull. 540, pp. 68, 69.

Texas Consolidated Mine was one of the important producers of Old Diggings district for many years. Three veins were worked and according to past report showed little barren quartz. A 20-stamp mill was supported for several years on the ore from this mine. The main lower adit was run 1600 feet, N. 10° E., and is 910 feet below the outcrop following the main vein which dips 70° east and is said to have been 8 to 12 feet wide. It was faulted, and the last development work, which was done by Harvey Sallee in 1922 and 1923 consisted of two crosscuts, one to the east and one to the west, in search of the ore-shoot. The mine was idle in 1926.

Bibl: Cal. State Min. Bur. R. X, pp. 629-630; XI, pp. 395-397; XII, p. 258; XIII, p. 365; XIV, p. 800; XVIII, p. 206; XIX, p. 137.

Washington Mine. Owner, Washington Gold Mining Company. Original Washington claim and millsite contain 82 acres, patented, in Secs. 16, 17, T. 33 N., R. 7 W. Address C. C. Fox, French Gulch, and Dr. G. A. Grotefend, Redding.

This property covers most of the hill between the forks of French Gulch. It is the oldest quartz mine in the county and one of the very oldest in the state, as it was located in 1852. It became a producer soon after and continued in operation off and on for about 50 years. The total production is indefinite, but is variously claimed to have been from \$1,000,000 to over \$2,000,000.

The workings consist of a series of six adits from 300 to 2400 feet long, through which the mine has been developed from near the creek level at an elevation of 2000 feet, to 2900 feet elevation, near the top of ridge. The workings are partly in the slate, above 2400 feet elevation, and in meta-andesite below that. Two veins, one striking north and dipping 60° to 70° east, the other striking a little north of east and dipping north, have been worked. Small stringers and veinlets of quartz, occurring in proximity to many small dikes of soda granite porphyry, branch off and have yielded numerous gold pockets. According to H. G. Ferguson, the north-striking vein cuts off the other, which has been more extensively worked. The largest of the old stopes is said to be 400 feet long, 5 feet wide and 250 feet high. The vein pinches and swells. It is principally quartz with a small amount of galena, sphalerite, pyrite and arsenopyrite. The north-striking vein is in a well-defined fault and has lenses of quartz up to 10 feet wide.

The property was leased in 1922 to Thomas Salisbury and associates who employed 15 men and did some work as the Washington Development Company. Some ore was crushed during the year and 400 tons is said to have yielded \$5 a ton free gold, but no important development resulted. At present, April, 1926, Fox and Grotefend have three men

employed. They are driving ahead on ore in an adit 300 feet long. There is a 5-stamp mill on the property.

Bibl: Cal. State Min. Bur. R. X, p. 635; XI, p. 50; XII, p. 260; XIII, p. 368; XIV, p. 804; XVIII, pp. 43 and 138. U. S. Geol. Surv. Bull. 540, pp. 64-66.

West End Mine. It is situated one mile southeast of Whiskeytown, in Sec. 16, T. 32 N., R. 6 W., in the Stella Mining District.

Property consists of West End Quartz mine and one-quarter section of patented land; total area is 180 acres. Owners: Dr. E. P. Mitchell of Winters, John Kesler of Anderson, and Western Star Lodge of Masons of Shasta. Under option to C. D. Jones & Company of Santa Barbara, California, in 1923.

Two quartz veins occur in the alaskite-porphyry; the West End vein strikes N. 50° W., dips 70° east; the Spanish vein strikes N. 27° E., and dips 80° west. These two veins evidently intersect about 90 feet south of the shaft. The veins vary in width from a few inches up to 2 feet. The ore is white quartz, showing free gold and some iron pyrite. On the 100-foot level, especially near the veins, the rock is much sheared. The alaskite-porphyry adjacent to the vein is in places partly silicified; and elsewhere near the veins is chloritized; in both situations a small amount of pyrite has been introduced. The zone of intense alteration of the porphyry is confined to the close proximity of the veins, and the silicified and chloritized porphyry carries no gold. In the siliceous phase, the alteration consists in the introduction of quartz along narrow and closely spaced fissures.

The development work has been confined to the West End and Spanish veins on the 50- and 100-foot levels, north of the shaft. Developments: Vertical shaft 100 feet deep. At 31 feet below the collar of the shaft, a drift was driven N. 19° E., and cut the West End vein, 110 feet from the portal, then continued 35 feet N. 16° E., and drifted on the vein N. 15° W., 180 feet, where the vein was cut off by a fault, which strikes N. 70° W., and dips 50° north. About 40 feet from where the vein was cut on this level, a crosscut was driven 100 feet N. 45° E., where it cut the Spanish vein, and this vein was drifted on 50 feet north and 55 feet south. On the 100-foot level, the West End vein was drifted on 200 feet north, to where the vein was cut off by the fault striking N. 70° W. A pump was installed by the last company and the mine unwatered. At 130 feet north of the shaft, a crosscut has been driven 80 feet N. 80° E., where the Spanish vein was cut, and a raise run on this vein in hopes of picking up the ore shoot developed in the Spanish stope, which has been stoped out for a distance of 60 feet along the vein from the drain tunnel level to the surface.

Equipment: 9-h.p. Hercules gasoline engine driving 6" Mast-Foss rod pump; 30-h.p. boiler and steam hoist. Idle in 1926.

Bibl: Cal. State Min. R. XII, p. 260; XIII, p. 368; XVIII, pp. 96, 256, 295-296, 409-410; XIX, p. 11.

TABLE OF QUARTZ MINES AND PROSPECTS, SHASTA COUNTY.

Name of mine	Location			Nearest town	Bibliography
	Sec.	T.	R.		
Accident					See Sybel.
Advance Cons.	2	35 N.	6 W.	7 miles west of Delta	R. XIV, p. 777.
Alice (Alice Cons.)	19	32 N.	5 W.	1 mile SW. of Keswick	R. XII, p. 245; XIII, p. 349; XIV, p. 778; XVII, p. 519.
Alice				6 miles NW. of Ono	R. XIII, p. 245; XIII, p. 349.
Alliance				5 miles W. of Redding	R. XIII, p. 349.
Alvina				4 miles N. of Horsetown	R. XIII, p. 349.
Al Toland	26	36 N.	6 W.	7½ miles W. of Delta	R. XIV, p. 778.
American	12, 13	33 N.	7 W.	3½ miles NE. of French Gulch	R. VIII, pp. 564-65; X, p. 637; XII, p. 245; XIII, pp. 349, 357; XIV, p. 778; XIX, p. 135; XX, p. 15. U.S.G.S. Bull. 540, pp. 35, 60-61.
Anavina					See Peerless Mine.
Annie				2 miles from Shasta	R. XIII, p. 349.
Arbuckle					See Bell Cow.
Atlantic	17, 20	31 N.	6 W.	3 miles NW. of Igo	R. XIV, p. 779.
Australia	19, 30	32 N.	6 W.	3 miles N. of Shasta	R. XIII, p. 362; XIV, p. 779.
Backbone				4 miles SW. from Kennett	R. XIII, p. 350.
Banghart					See Mad Mule.
Bell				7 miles W. from Ono	R. XII, p. 245.
Bell Cow	35, 36	30 N.	9 W.	18 miles SW. of Ono; 38 miles SW. of Redding	R. XVIII, pp. 296, 493-94.
Big Four				4 miles SW. of Shasta	R. XIII, p. 350.
Billy McCormick				13 miles NW. from Ono	R. XIII, p. 350.
Black Bear	9	22 N.	10 W.	1 mile S. of Harrison Gulch	R. XIII, pp. 350, 359; XIV, p. 779.
Black and Brown Bear				6½ miles W. of Kennett	R. XIII, p. 350.
Black Cloud and Red Cloud	15	32 N.	5 W.	4½ miles N. of Redding; 2½ miles from Keswick	R. XVII, p. 520.
Black Diamond Group	5	31 W.	18 W.	4 miles W. of Redding	R. XVIII, p. 296.
Blackfoot				4 miles S. of Shasta	R. XII, pp. 245-46; XIII, p. 350.
Black Hawk	14	31 N.	6 W.	1 mile NW. of Centerville	R. XIV, p. 779.
Black Prince					See Diamond Mine.
Black Spider	19	32 N.	5 W.	1½ miles SW. of Keswick	R. XII, p. 246; XIII, p. 350; XIV, p. 779.
Black Tom					See Niagara.
Bodie	6	32 N.	7 W.	3 miles SW. of French Gulch	R. XIV, pp. 779-80.
Bonanza	32	33 N.	7 W.	4 miles NW. of Stella	R. XII, p. 256; XIII, p. 364; XIV, p. 779; XIX, p. 11.
Bowery Bell	6	32 N.	6 W.	2½ miles NE. from Shasta	R. XIII, pp. 350-51.
Brackett					See Minnehasta.
Bright Star	31	32 N.	6 W.	4½ miles NW. of Stella	R. XII, p. 250; XIII, p. 359; XIV, p. 780. U.S.G.S. Bull. 540, p. 55
Brunswick	20	33 N.	7 W.	5 mile. W. of French Gulch	R. XIII, p. 351; XIV, p. 780; Bull. 540, pp. 35, 37, 68.
Bulwer and Virginia	18	33 N.	7 W.	5 miles NW. of French Gulch	R. XIV, p. 780.
Bullard and Vandever				12 miles NW. of Redding	R. XIII, pp. 351, 368; XII, pp. 259-60.
Bunker Hill	29	32 N.	5 W.	3 miles E. of Shasta	R. XIV, p. 781.
California and Oregon				3 miles SW. from Kennett	R. XIII, p. 351.
Calumet Consolidated	20	32 N.	5 W.	1 mile S. of Keswick	R. VIII, p. 563; X, pp. 631-32; XI, pp. 43, 395; XIV, p. 781.
Carnegie Group	1	33 N.	6 W.	7½ miles W. of Kennett	R. X, pp. 640-41; XI, p. 399; XII, p. 246; XIII, p. 351; XIV, p. 781.
Celestine					Now Double Header.
Central	33, 34	33 N.	5 W.	2½ miles E. of Copley	R. VIII, pp. 565-566; X, p. 631; XII, p. 246; XIII, p. 351; XIV, p. 782; XVIII, p. 494.
Chapman and Volutine	25	36 N.	6 W.	¾ mile S. of Centerville	R. XIV, p. 782.
Clara	17	32 N.	5 W.	½ mile W. of Keswick	R. XIV, p. 782.
Cleveland	15	32 N.	5 W.	4 miles W. of Redding	R. XIV, p. 782.
Climax Mine	16, 21	31 N.	6 W.	3 miles NW. of Igo	R. XIV, p. 782.
Clipper and Snider					See Carnegie Group.
Colorado	16, 17	33 N.	7 W.	3 miles NW. of French Gulch	R. XIV, p. 782.
Colorado				2 miles SW. from Shasta	R. XII, pp. 246, 256; XIII, p. 352.
Compton	20	33 N.	5 W.	1¼ miles S. of Keswick	R. XIV, p. 782.
Cons. Kaseinaska	10	32 N.	5 W.	4 miles NW. of Redding	R. VIII, p. 570; XII, p. 254; XIII, p. 352; XIV, p. 783; XVIII, p. 354.
Copley Mine	32	33 N.	5 W.	Near town of Copley	R. XIII, p. 352; XIV, p. 783.
Corrine	32	32 N.	5 W.	1 mile W. of Redding	R. XIV, p. 783.
Crown Point				6 miles W. from Delta station	R. XIII, p. 353.

TABLE OF QUARTZ MINES AND PROSPECTS, SHASTA COUNTY—Continued.

Name of mine	Location			Nearest town	Bibliography
	Sec.	T.	R.		
Daisy				5 miles N. of French Gulch.	R. XIII, p. 353.
Deakin & Taylor					See Old Spanish.
Delta Cons.	{ 1, 3, 6, 31	35 N. 36 N.	5 W. 5 W.	{ 6½ miles W. of Delta	R. XIII, p. 353; XIV, p. 784.
Diamond Mine	18	31 N.	6 W.	4 miles NW. of Igo	R. XIII, pp. 355, 350; XIV, p. 784.
Doebelns.				2 miles E. of Igo	R. XII, p. 247; XIII, p. 355
Dolocoath				2 miles E. of Shasta	R. XII, p. 247; XIII, p. 355.
Don Carlos					R. XI, p. 398.
Double Header	33	33 N.	7 W.	2 miles W. of Tower House.	R. VIII, pp. 567-68; XVIII, pp. 138, 256, 354, 405; XIX, p. 11.
Dreadnaught				3 miles NW. from Shasta	R. XII, p. 247; XIII, p. 355.
Early Discovery				Near Shasta	Field Report, 1921.
Eastern Star				14 miles SW. of Redding	R. XII, p. 247; XIII, p. 355.
Edna B.	6	31 N.	5 W.	1½ miles E. of Shasta	R. XII, p. 247; XIII, p. 355; XIV, p. 785.
El Dorado	3	32 N.	7 W.	17 miles NW. of Redding; ¼ mile SW. of Tower House.	R. XII, p. 247; XIII, pp. 355-56; XIV, p. 785; XVIII, pp. 405-406; XIX, p. 11. U.S.G.S. Bull. 540, pp. 56-57.
Emigrant					See Truscott.
Empire	9	30 N.	7 W.	3 miles SW. of Ono	R. XIII, p. 356; XIV, p. 785.
Empire	18	33 N.	7 W.	5 miles NW. of French Gulch	R. XIII, p. 356; XIV, p. 785.
Enright					See Old Spanish.
Esperanza	29	29 N.	10 W.	1½ miles E. of Harrison Gulch	R. XIV, p. 785.
Ethel				14 miles SW. of Redding	R. XII, p. 248.
Eureka Tellurium	32	32 N.	5 W.	3 miles SW. of Redding	R. VIII, p. 571; XI, p. 43; XII, p. 248; XIII, p. 356-57; XIV, p. 786.
Eureka					R. XVIII, p. 354.
Evening Star	4	32 N.	5 W.	2 miles SE. of Copley	R. XIV, p. 786; XVII, p. 520.
Florence	18	30 N.	7 W.	8 miles SW. of Ono	R. XIV, p. 786.
Florida Group	7, 12, 18	31 N.	5 W.	7 miles W. of Redding	R. XII, p. 248; XII, p. 357; XVII, p. 520; XVIII, p. 494.
Franklin	29	32 N.	5 W.	1½ miles SE. of Keswick	Field report.
French Gulch					See American Mine.
Gage and Martin				1½ miles S. of Shasta	R. XIII, p. 357.
Gambrius	16	32 N.	6 W.	In town of Stella	R. XIV, p. 786. U.S.G.S. Bull. 540, pp. 38, 39, 50, 51.
Ganim	5, 8, 15	32 N.	6 W.	2½ miles NW. of Whiskey-town	R. XVIII, pp. 730-31; XIX, p. 11; XX, p. 15.
Garfield	34	33 N.	5 W.	2 miles E. of Copley	R. XI, p. 397; XIV, p. 787.
Gem Cons. Group		31 N.	5 W.	4 miles NW. of Redding	R. X, p. 632.
Gladys	34	32 N.	6 W.	10 miles NW. of Redding	R. XVII, p. 521.
Gladstone	{ 1, 7, 8, 12, 18	33 N. 33 N.	6 W. 7 W.	{ 4½ miles NE. of French Gulch	R. VIII, pp. 568-69; X, p. 637; XI, p. 45; XII, pp. 248-49; XIII, p. 357; XIV, p. 787; XVIII, pp. 43, 96, 256; XIX, p. 11. U.S. G.S. Bull. 540, pp. 35, 37, 46, 57-60.
Gold Bar				4 miles NE. from French Gulch	R. XIII, p. 358.
Gold Bar No. 1-4	22, 26	33 N.	5 W.	10 miles N. of Redding	R. XIX, p. 93.
Golden Crown	19	31 N.	6 W.	2 miles NW. of Redding	R. XIV, p. 788.
Golden Queen Group				5 miles NW. of Redding	R. XVIII, p. 354.
Gold Leaf	5	31 N.	5 W.	4 miles E. of Redding	R. XIII, p. 358; XVII, pp. 521-22; XVIII, pp. 296, 298, 354, 406, 495; XIX, p. 11.
Gossan				3 miles W. of Delta Station.	R. XIII, p. 358.
Gray Eagle					See Sunny Hill.
Green				3½ miles W. of French Gulch	R. XII, p. 249; XIII, p. 358.
Grey Eagle	10	29 N.	10 W.	1 mile S. of Harrison Gulch	R. XIV, p. 789.
Grey Gold and Silver				2 miles SW. of Shasta	R. XII, p. 249; XIII, p. 358.
Haleyon	17	33 N.	7 W.	4 miles NE. of French Gulch	R. XIV, p. 789.
Hall's				10 miles NW. of Ono	R. XIII, pp. 358-59.
Happy Jack Group	{ 28, 32, 33	31 N. 32 N.	6 W. 6 W.	{ 10 miles E. of Redding	R. XIV, p. 770; XVII, p. 522.
Harrison Gulch					See Midas Mine.
Hartman				3½ miles N. of Stella	R. XII, p. 250; XIII, p. 359.
Hidden Treasure				8 miles NE. of Shasta	R. XII, p. 250; XIII, p. 359.
Highland	35	33 N.	6 W.		R. XIX, p. 136.
Highland	14	33 N.	7 W.	2 miles NE. of French Gulch	R. XIV, p. 789. U.S.G.S. Bull. 540, p. 69.
Holman				2 miles SW. of Copley	R. XIII, p. 359.
Hope	8	32 N.	7 W.	5 miles SW. of French Gulch	R. XIV, p. 790.

TABLE OF QUARTZ MINES AND PROSPECTS, SHASTA COUNTY—Continued.

Name of mine	Location			Nearest town	Bibliography
	Sec.	T.	R.		
Hull and Murray				4 miles N. of Shasta	R. XII, p. 250.
Index Group	6	32 N.	6 W.	$\frac{1}{2}$ mile N. of Oak Bottom	R. XIX, p. 57.
Indiana				Near Copley	R. XIII, p. 359.
Inez	19, 20	32 N.	5 W.	$\frac{3}{4}$ mile S. of Keswick	R. XIV, p. 790.
Iron Mask					See Bright Star.
Jackson					See Billy McCormick.
Janice Group	11, 12	32 N.	6 W.	3 miles NW. of Keswick	R. XVIII, p. 598.
Jerusalem	9	31 N.	8 W.		R. XIII, p. 360.
J. I. C.	13	33 N.	7 W.	3 miles NW. of French Gulch	R. XII, pp. 252-51; XIII, p. 360; XIV, p. 790.
Jim Fisk				3 miles N. of Igo	R. XII, p. 251; XIII, p. 360.
Joe Davis				11 miles W. of Ono	R. XIII, p. 360.
Jubilee	23	31 N.	6 W.	$\frac{1}{2}$ mile from Centerville	R. XIV, p. 790.
Jumbo	18	31 N.	5 W.	6 miles SW. of Redding	R. XVI, pp. 522-23.
Kit Carson	3	32 N.	5 W.	$2\frac{1}{2}$ miles SE. of Copley	R. XIV, p. 790.
Lacomia	1	35 N.	6 W.	7 miles W. of Delta	R. XIV, p. 790.
Last Chance					R. XVIII, p. 296.
Last Chance				$2\frac{1}{2}$ miles NE. of Igo	R. XII, p. 251.
Liberty	31	33 N.	5 W.	$1\frac{1}{2}$ miles NW. of Copley	R. XIV, p. 790.
	36	33 N.	6 W.		R. XIII, p. 361.
Little Maud				7 miles from Shasta	R. XIII, p. 361.
Live Oak				4 miles N. of Redding	R. XIII, p. 361.
Lodi	16	31 N.	6 W.	$3\frac{1}{2}$ miles N. of Igo	R. XII, p. 252; XIII, p. 361; XIV, p. 791.
Lost Buck				6 miles NW. of Ono	R. XII, p. 252; XIII, p. 361.
Lucky Bart				16 miles W. of Delta	R. VIII, pp. 569-70.
McCarthy, Saeltzter and Smith				$4\frac{1}{2}$ miles NW. from Redding	R. XIII, p. 361.
Mad Mule	32	33 N.	6 W.	5 miles NW. of Stella	R. IX, p. 38; XI, p. 397; XII, p. 252; XIII, p. 361; XIV, p. 791; XIX, p. 11. U.S.G.S. Bull. 540, pp. 40, 42, 52-54.
Maduro	20	32 N.	5 W.	mile S. of Keswick	R. XIV, p. 792.
Manlove				$3\frac{1}{2}$ miles N. of Stella	R. XII, p. 252; XIII, p. 362.
Mascot					See West End Mine.
McCall	32	36 N.	5 W.	7 miles SW. of Delta	R. XIV, p. 792.
McKinnon	6	35 N.	5 W.	$7\frac{1}{2}$ miles W. of Delta	R. XIV, p. 792.
Mechado				3 miles NE. of Igo	R. XII, p. 252; XIII, p. 362.
Midas	3, 4, 10	29 N.	10 W.	52 miles SW. of Redding	R. XIV, p. 792; Pre. Rep. No. 8, p. 18.
Milkmaid and Franklin	17	33 N.	7 W.	3 miles from French Gulch	R. XIV, pp. 793-94; XVIII, pp. 43, 406-407; XIX, p. 11. U.S. G.S. Bull. 540, pp. 35, 61, 63, 64.
Miner's Dream				$3\frac{1}{2}$ miles S. of Shasta	R. XII, p. 252; XIII, p. 362.
Minnehasta	33	32 N.	5 W.	4 miles W. of Redding	R. XVII, p. 523.
Minnesota	1, 2	32 N.	6 W.	2 miles SW. of Copley	R. X, p. 635; XII, p. 255; XIII, p. 363; XIV, p. 794.
Mt. Pleasant	32	32 N.	5 W.	1 mile W. of Redding	R. XIV, p. 794.
Mocking-Bird				14 miles SW. of Redding	R. XII, p. 253.
Moline				3 miles N. of Shasta	R. XIII, p. 362.
Mount Shasta	33	32 N.	6 W.	3 miles S. of Stella	R. XIV, p. 794. U.S.G.S. Bull. 540, pp. 39, 44, 46, 47-48.
Mtn. Monarch Group					See Happy Jack Group.
Mountain View	10	32 N.	5 W.	8 miles N. of Redding	R. XVIII, p. 354.
Mountain Top				5 miles W. from Redding	R. XIII, p. 362.
Morton and Bliss	1	33 N.	6 W.	$6\frac{1}{2}$ miles W. of Kennett	R. VIII, p. 564; XI, pp. 398-99; XIV, p. 794.
Murray	18	32 N.	5 W.	$1\frac{1}{2}$ miles N. of Keswick	R. X, p. 365; XII, p. 253; XIII, p. 362; XIV, p. 795.
Nellie and Annie	1, 2	33 N.	7 W.	5 miles N. of French Gulch	R. XIV, p. 795.
Nelson				7 miles N. of Stella	R. XII, p. 253; XIII, p. 362.
New Year and Australian				$1\frac{1}{2}$ miles N. of Shasta	R. XIII, pp. 362-63.
New York and Skylark	17	33 N.	7 W.	4 miles NW. of French Gulch	R. XIV, p. 795.
Niagara	1, 6, 7, 8, 15, 18	33 N.	7 W.	$4\frac{1}{2}$ miles from French Gulch	R. X, pp. 636-37; XI, p. 50; XII, p. 253; XIII, p. 363; XIV, p. 793; XVIII, pp. 43, 296; XX, p. 15. U.S. G. S. Bull. 540, pp. 35, 37, 44, 67.
North Star	18	31 N.	6 W.	4 miles NW. of Igo	R. XII, p. 253; XIV, p. 798.
North Star	9	33 N.	7 W.	25 miles SW. of Redding	R. XVII, p. 523.
North Star	6	32 N.	6 W.		R. XVII, p. 523.
Old Massachusetts Group					R. XVIII, p. 495.
Old Spanish	31	32 N.	5 W.	2 miles W. of Redding	R. XII, pp. 246-47; XIII, p. 353; XIV, p. 796.
Olive	19	32 N.	5 W.	$1\frac{1}{2}$ miles SW. of Keswick	R. XIV, p. 796.
Oro Fino	34	32 N.	6 W.	1 mile E. of Shasta	R. XI, p. 44; XIV, p. 796.
Oro Vista	36	32 N.	6 W.	$\frac{1}{2}$ mile SE. of Shasta	R. XIV, p. 796.

TABLE OF QUARTZ MINES AND PROSPECTS, SHASTA COUNTY—Continued.

Name of mine	Location			Nearest town	Bibliography
	Sec.	T.	R.		
Peerless Group.....	23	31 N.	6 W.	8 miles SW. of Redding....	R. XII, p. 245; XIII, p. 349; XVIII, pp. 598-99.
Potosi.....	15	31 N.	6 W.	1½ miles NW. of Centerville	R. XII, p. 254; XIII, p. 363; XIV, p. 796.
Pugh and Lindsay Quartz Hill.....				3 miles W. of Shasta.....	R. XII, p. 254; XIII, p. 363. See Cons. Kascinaska. See Minnesota.
Rattler.....					R. XVII, p. 523.
Rawhide.....	19	32 N.	5 W.	2½ miles from Keswick....	R. XIII, p. 363.
Red Bluff.....				15½ miles NW. of Ono.....	R. XII, p. 255; XIII, p. 363.
Red Cloud.....				4 miles W. of Igo.....	R. XIV, p. 797; XVIII, p. 408; XIX, p. 11; XX, p. 15.
Reid Mine.....	3	32 N.	5 W.	8 miles N. of Redding.....	See Colorado.
Remonia, D. and B. Reservoir and Offset.....					See Black Cloud and Red Cloud.
Richmond.....				3½ miles W. of Igo.....	R. XII, p. 256; XIII, p. 364.
Rickard.....				5½ miles W. of Delta.....	R. XIII, p. 364.
Riley and Bliss.....					See Morton and Bliss.
Ruby and Pearl.....	4	38 N.	5 W.	12 miles W. of Castella....	R. XIV, p. 797; XVIII, p. 354; XIX, p. 11.
Sam Houston.....	34	33 N.	5 W.	2 miles E. of Copley.....	R. XIV, p. 797.
Sanders and Vollmer.....				5½ miles W. of Delta.....	R. XIII, p. 364.
Scottish Chief.....	31	33 N.	5 W.	½ mile NW. of Copley.....	R. XIV, p. 797.
Shasta View (Bonanza Gold Dollar).....				2 miles N. of Shasta.....	R. XVIII, p. 256; XX, p. 15.
Siskiyou and Nightingale..	2	35 N.	6 W.	7 miles W. of Dog Creek rail- road.....	R. XIV, p. 798.
Slatonas.....				4 miles W. of Delta.....	R. XIII, p. 364.
Slide.....	7, 8	32 N.	5 W.	1 mile N. of Keswick.....	R. XIV, p. 799.
W. W. Felts and I. Smith. South Star Mine.....	32	33 N.	7 W.		See Jumbo Prospect.
Sparby.....				2½ miles SW. of Copley....	R. XVIII, p. 256.
Spring Gulch.....				7½ miles NW. from Stella..	R. XII, p. 257; XIII, p. 364.
Surprise Gold Mining and Milling Company.....				1¼ miles N. of Shasta.....	R. XII, p. 257.
Summit.....					See Sunny Hill.
Summit & Montezuma.....	17	33 N.	7 W.	5 miles W. of French Gulch	R. X, p. 641; XIII, p. 365; XIV, p. 799; XVIII, pp. 206, 256.
Sunny Hill.....	1	30 N.	8 W.	7 miles W. of Ono, 25 miles SW. of Redding.....	R. XII, p. 257; XIII, p. 365; XIV, p. 799.
Sybel.....	7	33 N.	7 W.	5 miles NW. of French Gulch	R. XIV, p. 777; XVIII, pp. 43, 138, 296, 408; XIX, p. 11. U.S. G.S. Bull. 540, pp. 68-69.
Tanglefoot.....	12	30 N.	8 W.	8 miles SW. of Ono.....	R. XIV, p. 799-800.
Texas Cons.....	32, 33	33 N.	5 W.	1 mile E. of Copley, 9 miles N. of Redding.....	R. X, pp. 629-30; XI, pp. 43, 396- 97; XII, p. 258; XIII, p. 365; XIV, p. 800; XVIII, p. 206; XIX, pp. 11, 58, 137.
Thompson.....				2½ miles SW. of Shasta....	R. XII, p. 258; XIII, p. 367.
Three Sisters.....	15	33 N.	7 W.	2 miles NW. of French Gulch	R. XIII, p. 367; XIV, p. 800.
Tom Green Mine.....	15	33 N.	7 W.	5½ miles W. of French Gulch	R. XIV, p. 800.
Topknot.....				5½ miles from Delta.....	R. XIII, p. 367.
Trinity Cons.....	1, 2	35 N.	6 W.	West of Delta.....	R. VIII, p. 569; XIII, p. 357; XIV, p. 802. U.S.G.S. Bull. 540, pp. 35, 37, 54, 55.
Truscott.....	25	32 N.	7 W.	6 miles NW. of Stella.....	R. VIII, pp. 571-72; XII, p. 248; XIII, p. 356; XIV, p. 802.
Uncle Sam.....	1, 6	33 N.	6 W.		R. X, pp. 639, 310; XI, pp. 47, 395, 398; XII, pp. 258-59; XIII, pp. 367-68; XIV, pp. 802-803; XIX, p. 56; XX, p. 15.
Utah and California.....	3, 4	32 N.	5 W.	2 miles SE. of Copley.....	R. X, pp. 630-31; XI, p. 397; XII, p. 259; XIII, p. 368; XIV, p. 803.
Victor.....	3	29 N.	10 W.	In the town of Harrison Gulch.....	R. X, pp. 635-36; XI, p. 50; XII, p. 260; XIII, p. 368; XIV, pp. 803-804. U.S.G.S. Bull. 540, pp. 35, 37, 44, 64-66.
Walker.....					See Utah and California.
Walker's, Frank.....				4 miles W. of Redding.....	R. XVIII, p. 296.
Washington.....	16, 17	33 N.	7 W.	3 miles NW. of French Gulch	R. X, pp. 635-36; XI, p. 50; XII, p. 260; XIII, 368; XIV, p. 804; XVIII, p. 43; XIX, p. 11. U.S. G.S. Bull. 540, pp. 35, 37, 44 64-66.

TABLE OF QUARTZ MINES AND PROSPECTS, SHASTA COUNTY—Continued.

Name of mine	Location			Nearest town	Bibliography
	Sec.	T.	R.		
West End.....	16	32 N.	6 W.	1 mile SE. of Whiskeytown.	R. XII, p. 260; XIII, p. 368; XVIII, pp. 96, 256, 295-96; 409-10; XIX, p. 11.
Western.....					See Milkmaid and Franklin.
West Point.....				3½ miles from Shasta.	R. VIII, p. 570; XII, p. 260; XIII p. 368.
White Oak.....				2½ miles NE. from Shasta.	R. VII, p. 571.
World's Fair.....				2½ miles NW. of Igo.	R. XII, p. 260; XIII, p. 368.
Willard and Williams.....	19	32 N.	5 W.	1 mile E. of Keswick.	R. XVII, p. 523.
Yankee John.....		31 N.	5 W.	6 miles SW. of Redding.	R. XVII, p. 524; XVIII, p. 495; XIX, p. 11.
Yellow Jacket.....				3 miles NE. of Copley.	R. XII, p. 260; XIII, p. 368.

GOLD (PLACER MINING).

The streams of Shasta County drain into Sacramento River and placer mining along them is therefore subject to debris restrictions. There has been no hydraulic mining in the county for many years past, although some gravel suitable for working by this process remains in the Clear Creek drainage, near French Gulch, and a larger acreage in the Igo district. The prospective placer gold production will be principally from this stream.

The productive placer mining sections of the county were nearly all west of Sacramento River, as the streams entering the river from the east drain formations which carry little gold, being either barren sedimentary rocks or recent, unmineralized lava. Besides Clear Creek, the next most important placer mining operations in late years were along Cottonwood Creek, which is the county line between Shasta and Tehama Counties west of Sacramento River. Smaller streams such as Oregon Gulch and Olney Creek were rich in early days. Hazel Creek and a small area on Montgomery Creek carried about the only gold-bearing gravel east of Sacramento River.

The conglomerate on the eastern shore of the Cretaceous Island of northern California supplied gold and platinum to the later streams, notably to sections of Clear Creek and the northerly tributaries of Cottonwood Creek. These conglomerates occur in the southwestern part of the county, passing west and southwest from Redding to the Igo and Ono districts, and to the Bald Hills and Beegum Peak, the latter being a prominent landmark covered by the conglomerate.

While there are large accumulations of gravel north of Redding, both in bars along Sacramento River and as ancient high shore gravels, mining of these has been, on the whole, disappointing, as mentioned under dredging.

The known available placer ground, not counting the numerous small diggings where one or two men working alone sometimes make a "strike," consists of 2000 to 3000 acres in the Igo district; a few hundred acres along Clear Creek 3½ to 4 miles north of French Gulch, including such land as the Robert Williams and George Martin properties, the latter now being worked by Jenkins and Taylor; perhaps 250 acres on Clear Creek near Horsetown; some land on Roaring River near Gas Point, which has lately been noticed as a dredging possibility; some unprospected and very indefinite possibilities in the Anderson

district; and small areas along Sacramento River which might be selected from such large holdings as that abandoned by American Dredging Company.

GOLD (DRIFT MINES).

Grubstake Placer Mine. Owners, Nelson Brothers, La Moine, California. Property is in Sec. 22, T. 36 N., R. 5 W., in the Slate Creek mining district, one mile south of La Moine. It is in the Shasta National Forest and contains a small amount of oak, pine and fir. Elevation 1260 feet. The claim was located in 1917 and contains 80 acres. Country rock is slate. Deposit consists of sloping gravel bars. The gravel channel being worked courses north and south, the gravel varying from 1 to 46 feet in depth. There is no cement, but boulders up to four tons are encountered. The slate bedrock is full of holes and crevices. Width of pay gravel about 40 feet and depth 30 inches. The portion of the claim being worked is located on a high bluff about 40 feet above the present river level. Here the gravel is about nine feet deep. The top dirt is moved to one side and the pay dirt moved out and dumped into a chute and run down to the river level, where it is washed in sluice boxes. Only worked in the winter on account of scarcity of labor and high wages.

Bibl: Cal. State Min. Bur. R. XVII, p. 525.

Hardscrabble or Piety Hill Mine was formerly a good producer. It covers 1700 acres of patented land in the Igo district, containing high gravel deposited by the ancient stream corresponding to Clear Creek. This property was worked previous to 1880 as a hydraulic mine, and afterward by drifting. At present it belongs to Happy Valley Land & Water Company, who are using the old ditches and water formerly employed in hydraulic mining, for irrigation. The mine has been idle for many years. The gravel is 50 feet deep in places but averages 20 feet.

Lost Channel Mine. The property lies immediately south of the Clear Creek drainage in the Igo mining district, 12 miles southwest of Redding. Holdings consist of 580 acres, located in sections 34, 3 and 4, T. 31 and 30 N., R. 6 W. Elevation is 1100 feet. Owner, C. A. Russell of Igo. The 'channel' is in all probability a section of the ancient bed and wash of Clear Creek. The width of this old channel is from one-half to fully one mile across. The present drainage of Upper Dry Creek passes directly across the course of the old channel in a southwesterly direction. Deepest depth of the channel is 80 feet.

Character of bedrock: At the northern end of the property, the wash overlies the slates and tuffs. For a distance of about one mile southwesterly, a soft decomposed granite bedrock exists, lying between the slates and sandstones. The sandstone is on the southerly end of the property.

Developments: On the south side of Dry Creek, there is fully 7000 to 8000 feet of workings near the Dunham tunnel. Since Report XIV (p. 791), the ground was prospected by a series of drill holes sunk on the north township line, 100 feet apart to a depth of 50 to 65 feet. North of the Dunham tunnel, 12 prospect shafts were sunk, 200 feet apart, east and west across the channel, the depth of these shafts to

bedrock being from 18 to 80 feet. Gravel tested ran from 4 to 60 cents per cubic yard, the average value being 12 cents per yard. The ground east and west of Harrison Gulch averaged 50 cents per cubic yard. Three channels have been developed, known as East, West, and Tom White. General course of the channel is north and south. In recent development work, a shaft has been sunk 34 feet deep to bedrock on Los Angeles Gulch. This shaft is one mile north of the Dunham tunnel. To the south of this shaft, two other shafts have been sunk to bedrock. These three shafts are 100 feet apart. Gravel from these three shafts averaged 32 cents per cubic yard. Present work is confined to drifting south on the channel. The gravel mined in the south drift for a height of two feet above bedrock, averaged \$10 per cubic yard.

Character of Gold: Very little gold is shown of a size that could be classed as small nuggets except in the main channel, and in the present workings. The distribution in the general wash shows gold running about 10 colors to a cent on an average. Fineness, 0.873. Total production is reported to be \$3,000,000 from 1865 to the present time.

Equipment: Consists of 2-h.p. Fairbanks-Morse gas engine which drives hoist, rod pump and washing machine. Capacity of washer is 30 tons per 24 hours. Two men are employed in 1926, drift mining.

Bibl: Cal. State Min. Bur. R. XVIII, p. 599.

Woodfill Placer adjoins *Lost Channel Placer* on the same deposit. Idle. Geo. Woodfill, Igo, owner.

GOLD (DREDGING).

Extensive deposits of auriferous gravel occurred along Clear Creek for a distance of $7\frac{1}{2}$ miles from the mouth of its rocky canyon to Girvan, on the railroad below Redding. This section has been dredged for many years past and still contains some ground on which a dredger is being built at present (April, 1926).

William Diestelhorst was the pioneer dredger operator, using a steam scoop which is said to have been successfully worked for several years. In 1906, Shasta Dredging Company installed a dredger and operated for several years until their ground was exhausted. They worked up as far as the Gleason holdings, which are near the beginning of the canyon. Subsequently, several Oroville companies drilled the creek but did not operate. Lawrence Gardella later installed a dredger below the Shasta Dredging Company's land and continued work until the dredger was burned last year. The gravel is free washing, medium to small size and as much as 20 to 22 feet deep, but averages 12 to 15 feet. The deposit is one-fourth to one-half mile wide in places and bedrock was favorable for dredging, except in places where hard high reefs cross the stream and have prevented moving the dredger.

American Gold Dredging Company. (See under Sacramento River.)

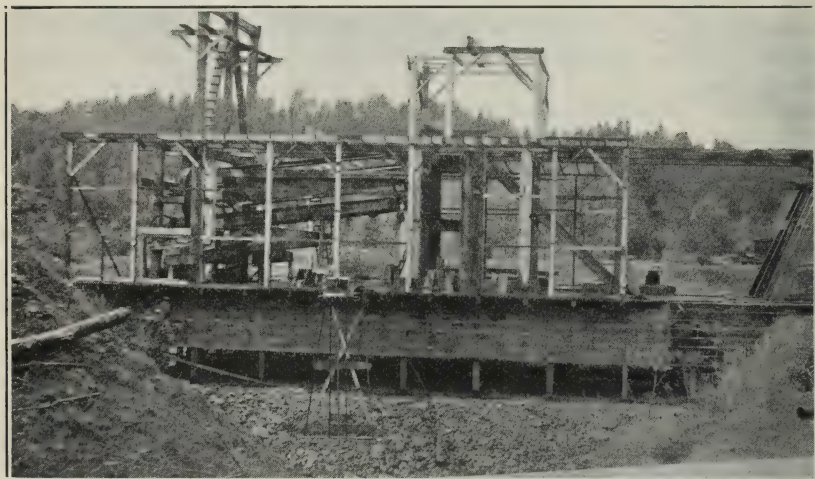
Big Chief and Little Chief Placer Claims are on Clear Creek near old Horsetown, about $6\frac{1}{2}$ miles by road from Girvan. Wm. L. and Helen M. Hill of Redding have given an option to purchase to Fred C. Anderson, who plans to put a P. & H. gasoline shovel on the claims to

work the gravel. Fifteen holes to an average depth of 20 feet are said to have given very satisfactory prospects.

Gleason Estate Placers are in SE $\frac{1}{4}$ of Sec. 36, T. 31 N., R. 6 W., on Clear Creek at old Horsetown, seven miles by road west of Girvan. James Gleason, Elizabeth Schroter and other Gleason heirs have recently agreed to sell the holdings, containing 110 acres, to Lawrence Gardella of Oroville for dredging.

The land lies near the upper end of the dredgable area, and the gravel is mostly fine to medium sized, 12 to 22 feet deep and about one-fourth mile wide where the creek spread out in past years over the flood plain, parts of which are now covered by a few feet of soil.

Gardella has just completed a wooden dredger hull 36' by 72', on which will be installed machinery from dredgers formerly operated by him on Clear Creek and elsewhere. He has shops and a camp 2 $\frac{1}{2}$



Wooden hull of Gardella dredge, under construction at Horsetown on Clear Creek.

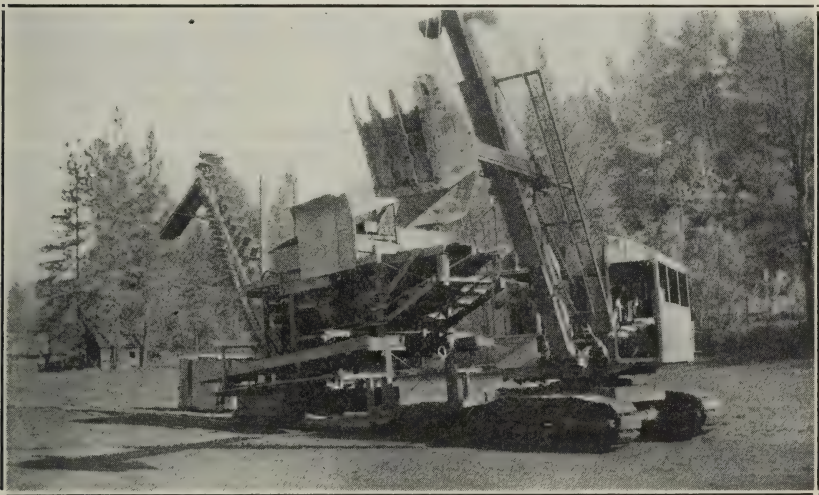
miles downstream. It is believed the dredger will be ready for operation about June first.

Gold Bar Placers, belonging to Wm. L. and Helen M. Hill of Redding, adjoin the Gleason Estate property upstream and contain 60 acres on Clear Creek. These claims have also been taken under option by Lawrence Gardella for dredging. The ground is similar to the Gleason property.

Jenkins & Taylor Placer. Owners, E. H. Jenkins and Charles Taylor, San Luis Obispo. Property is on Clear Creek 3 $\frac{1}{2}$ miles north of French Gulch and includes the George Martin Ranch and Drunken Gulch Placer Mine, a total of 140 acres.

The gravel along the stream and on the old back channels averages about 13 feet deep. There is a large area remaining unworked, probably two-thirds of the total acreage.

The present operators installed a P. & H. three-fourths yard gasoline shovel operated by a 65-h.p. engine, and have done extensive preliminary work, including some prospecting pits and a sluiceway across the property, through which Clear Creek can be diverted by damming it at the upper end of a large bend. For washing gravel, they have installed a Pierce Gold Machine, which is a small dry-land outfit patterned after one used in the placers near La Panza, where water is scarce. It carries a trommel about 4 feet by 16 feet, with three-fourths inch screen, through which fine gravel discharges on each side into four apron sluices $2\frac{1}{2}$ feet by 4 feet, thence to 30 feet of sluice $2\frac{1}{2}$ feet wide with Hungarian riffles. Coarse cobbles pass through the lower end of trommel to a bucket elevator with buckets two feet wide which is capable of stacking rocks 20 feet high or more. In operation, this machine is dragged around on skids by the gasoline shovel, which feeds



P. & H. gasoline steam shovel and Pierce gravel gold washing machine on Jenkins and Taylor Placer, near French Gulch. Photo by courtesy of Clifford Taylor.

gravel into the hopper. Power for the Pierce machine is furnished by a second-hand automobile engine working through chain and gear drives. A six-inch centrifugal pump supplies water for washing.

The ground is stated to prospect very well in gold and is free-washing, with wash mostly small and medium sized but some large boulders. The gasoline shovel is adapted to work such ground. The working capacity will be limited by the gravel washing machine and by the necessity for frequent moves.

Sacramento River.

Numerous attempts have been made to dredge the gravel of Sacramento River just northeast of Redding. Several small suction dredgers were tried without much success. Early in 1918, *American Gold Dredging Company* built a dredger with buckets of six cubic feet capacity designed to dig 40 feet below water level. They operated

intermittently during the next five years but later abandoned the property. This work was on the Menzel Ranch, containing 1000 acres along the north bank of the river opposite Redding. The ground was mostly suitable for dredging, and was 20 to 40 feet deep, with medium sized gravel, but it evidently did not come up to the grade indicated by drill prospects. William Diestelhorst, the pioneer dredger operator on the Sacramento River, found some good ground but states the gravel along the river is very spotty and much of it very low grade.

IRON.

Iron ore occurs in Shasta County at several places along the contact of the McCloud (Carboniferous) limestone and quartz-augite-diorite of late Jurassic or early Cretaceous age.* The principal outcrops noted are a mile and a half north of Heroult, where considerable ore has been mined; on the northeast side of Hirz Mountain; and on the north and west sides of Gray Rocks.

The deposits show limonite on the surface, but magnetite deeper, and are of the contact type. In places, pyrrhotite and chalcopyrite occur with the magnetite and this led to the belief that the deposits might prove on development to be the gossan of copper ore bodies.

A technically successful method of electric smelting of iron ores and alloys was followed at Heroult by Noble Electric Steel Company for several years.

California Consolidated Iron Mines. Owners, Ida Bass, E. M. Eaton, M. A. Gleaves, F. A. Forsythe and F. A. Forsythe, Jr. Contain 88.6 acres in Sec. 26, T. 34 N., R. 4 W. Idle, undeveloped.

Jennings Group. Owner last known, J. J. Jennings, Baird. Eleven claims, containing 220 acres, in Secs. 7 and 8, T. 35 N., R. 3 W., nine miles by road from Antler, and can also be reached by an old road, partly in bad condition, up McCloud River from Sacramento Valley and Eastern Railroad. The claims are on the northeast side of Hirz Mountain.

The claims were located in 1903 for gold, silver, copper and iron. Considerable prospecting work, consisting mostly of short adits and open cuts, was done and while all of these minerals are said to occur, the deposits are characteristically limonite and magnetite, of good grade, and have been estimated to contain 1,000,000 tons or more. Copper and iron sulphides in small amount are reported at 100 feet in depth. Idle.

Noble Electric Steel Company owns one-half of Sec. 21, the SW $\frac{1}{4}$ of Sec. 25, 80 acres in Sec. 35 and 94 acres in Sec. 26, all in T. 34 N., R. 4 W., near Heroult. The electric smelting plant has been idle since the war, but the processes used for producing charcoal pig iron, and later ferro-manganese and ferro-silicon are of interest technically and also in a general way as indicating the possibilities for such an industry in the future. While the products of this plant were of high quality, operation was costly and electricity in particular would have to be obtained at much lower cost than formerly available to make the process a financial success permanently in normal times.

* Diller, J. S., U. S. Geological Survey, Folio No. 133, Redding.

The furnaces were rectangular shells, 10 feet wide by 25 feet long by 8 feet high, lined with silica brick. Four carbon electrodes each 12 inches in diameter were suspended above the furnace, entering vertically. Furnaces were equipped with gravity feed. The different constituents of the charge were drawn from the respective bins into the scale car, which was dumped into a chute, the charge mixing as it fell to the furnace, where it was hand spread.

The plant was built about 1907 and until 1914 produced pig iron. Charcoal, barren quartz and limestone, and iron ore from the nearby Shasta Iron Company's claims, were charged together into the furnace, and a superior quality of pig iron, very low in sulphur and phosphorous and carrying from 1% to 5% silicon, was obtained. The daily capacity was 25 tons, with a crew of 12 men. Each of the electrodes used 1500 kilowatts of electricity.

After the war started, the making of ferro-manganese and ferro-silicon was begun. The manganese used was from mines in various parts of the state and the average analysis of it was:

Manganese (Mn)	40%
Silica (SiO ₂)	16%
Iron (Fe)	1% to 3%

Phosphorus and sulphur low or absent.

The local iron ore used carried 68% iron and 1% to 2% silica.

The furnace charge for making ferro-manganese was about as follows:

2000 lbs. manganese ore.
800 lbs. limestone.
60 lbs. fluorspar.
70 lbs. iron ore.
550 lbs. charcoal or coke (crushed fine).

The ferro-manganese produced averaged

For 70% product		For 80% product
70%	manganese	80%
20%	iron	12%
6%	carbon	6%
1% to 3%	silicon	1% to 3%

Phosphorus and sulphur absent or only traces.

Metal was tapped every three hours, at a temperature of 1400° C. and each furnace produced seven to eight tons of ferro-manganese in 24 hours. A recovery of 65% to 70% of the manganese in ore was made. This type of furnace could use coke made from petroleum residue, as no great strength was needed, and this material was used when obtainable. The high cost of coke from other sources and the cost of manganese ore were also big factors in cost of production.

For making 75% ferro-silicon, the following charge was used:

2000 lbs. siliceous material (85% SiO ₂ , 5%-10% Fe).
1000 lbs. charcoal.
400 lbs. iron ore (68% Fe, 1% to 2% SiO ₂)

This was tapped at 1550° C.

The enterprise was unable to survive the post-war adjustment period, but was a pioneer work worthy of attention from those seeking to develop the county's resources.

Peterson Group. (Deep Pit Group.) Owner T. H. Peterson, Heroult. There are 14 claims in Sec. 36, T. 34 N., R. 4 W., on south side of Pit River, one-half mile south of Heroult. They cover a large iron gossan. 500 feet wide by a mile long north and south. A number of short adits have been run, and are reported to show some pyrite and copper. The surface ore is considered valuable for mineral paint but none has been marketed yet, although the owner is reported to have had various offers.

Shasta Iron Company Group. (Pit River Iron Ore Mines, Magnetic, Ydalpom, Wintoon No. 1, and other claims.) These comprise 174 acres patented and six unpatented claims in Sec. 26, T. 34 N., R. 4 W., owned by Shasta Iron Company and operated under lease by Noble Electric Steel Company, 384 Mills Building, San Francisco, until about April, 1925.

The last named company operated intermittently for the first few years after the closing of their electric smelter, but for several years past and up to a year ago, had been shipping ore quite steadily and in considerable quantity to Pacific Coast furnaces. It was the principal producer of the state during that time.

The iron ore, which occurs as limonite on the surface and magnetite below, follows the irregular contact of McCloud limestone and quartz-augite-diorite, in a northeasterly direction. The orebody developed by numerous open cuts and adits is 1000 feet long by 150 feet wide and is estimated to contain 1,000,000 tons. The ore mined in the past seven years has contained 65% to 68% iron, 1% to 3½% silica, .02% sulphur and .012% phosphorus.

The mine was worked by two open quarries 140 feet apart in elevation. From the lower quarry it was trammed to the head of a gravity tram 1600 feet long, which delivered it to the railroad cars at Heroult, on the Sacramento Valley and Eastern Railroad. Besides shipping 10 to 15 cars of ore a month during their later operations, this company supplied 1500 tons of ore from which steel was made for the towers on the high-tension electric transmission lines from Pit River southward.

Bibl: Cal. State Min. Bur. R. XII, p. 327; XIV, pp. 805-806; Bull. 38, pp. 301-304. U. S. Geol. Survey, Redding Folio; Bull. 213, pp. 130, 219; Bull. 225, p. 178.

LEAD.

Lead has been produced in small quantity as a by-product from copper and silver ores. A few small prospects containing galena as the principal ore have been worked a little the past two years near the highway north of Ingot and near Round Mountain. The prospects visited are in Triassic limestone.

Asher Prospect (Jacksonian and other claims). Owners, James G. Asher and George S. Burns, Ingot. Under lease and option to C. A. Hill and Charles Walters, Ingot. There are four unpatented claims adjacent to the highway two or three miles north of Ingot.

A prospect shaft sunk just below the highway was full of water when visited. There was a small quantity of ore, carrying galena with a little zincblende, on the dump. The incline shaft was said to be 60 feet deep.

Cartwright Prospect. Owner, E. Cartwright, Round Mountain via Ingot. This is a lead prospect in Round Mountain district. The owner is working it.

Highgrade Lead Prospect. Owners, E. Cartwright, Ingot, and Hamilton and Morris, Chico. In $E\frac{1}{2}$ of $NW\frac{1}{4}$ of Sec. 27, T. 34 N., R. 1 W.

A vein carrying galena and zinchblende in about equal proportions, so far as could be judged from observation of the accessible section of it, strikes N. 18° E. and dips 30° W. Both walls are gray limestone and show gouges one-half inch wide.

The property was idle when visited and a 2-compartment inclined shaft was full of water within a few sets of the surface. South of this a few feet, the vein is six inches to a foot in width and carries a fair amount of galena and zincblende.

A small mill was built on the claim adjacent to the shaft a year or so ago but it is not known that any shipment of concentrate has been made.

LIMESTONE.

This mineral is said to occur more abundantly in the Redding quadrangle than in any similar area on the Pacific Coast. The McCloud (Carboniferous) limestone begins with small lenses near Lilienthal, eight miles northeast of Redding, extending thence northerly past the Baird fish hatchery, where the deposits are large and most conveniently located for working, and into the less accessible region of the upper McCloud river. Other deposits of Devonian age are found two to four miles west and northwest of Kennett. Limestone was produced for many years from the latter locality to supply smelter flux and lime for other local uses, but no work is going on now. Smaller bodies of it are also found in different parts of the county. The Hosselkus (Triassic) limestone is prominent east of Ingot and on Brock Mountain north of Pit River. Some of this was used for smelter flux at Ingot.

The McCloud limestone appears to be of greater prospective interest than the others because of the accessibility and size of the bodies near the fish hatchery. These bodies cover part of Sec. 12, nearly all of Sec. 13 and parts of Secs. 14, 23, 24 and 26, T. 34 N., R. 4 W., as well as parts of Secs. 6, 7, and 18, T. 34 N., R. 3 W. Of these, the more accessible holdings are those on the west and south sides. The Gray Rocks are in Sec. 3, T. 33 N., R. 4 W., from one-half to $1\frac{1}{2}$ miles south of Pit River and slightly closer to the railroad than the others.

The general description of this formation by Diller* will suffice for the various holdings.

"The limestone is dark gray and massive below, and somewhat thinner bedded above, with many nodules and sheets of gray chert, often containing silicified fossils.

"The largest and most accessible exposures of the McCloud limestone are at Gray Rocks, near Bayha * * * and opposite the United States fishery. The two localities are separated by quartz-augite, which cuts the limestone."

"* * * For 10 miles beyond Pit River the escarpment of McCloud limestone forms one of the principal topographic features, but it is very much cut up by quartz-augite-diorite into irregular patches of limestone separated from one another by distances varying from a few

* Diller, J. S., U. S. Geol. Survey, Folio No. 138, Redding, p. 3.

feet to over two miles. * * * The largest mass is that opposite the fishery.

"* * * In thickness, the McCloud limestone varies from 200 feet or less near the south end * * * to approximately 2000 feet in the prominent rugged mountain formed by it a short distance north-east of the fishery."

The principal holdings in this district are noted below. The properties mentioned are the most accessible, and would naturally be the first developed. Besides these, there are other limestone areas adjacent, but harder to reach, which are partly in unpatented land, or in Indian allotments or railroad sections.

Bayha Land Company (Lime Mountain Consolidated) owns a large part of the Gray Rocks Deposit in the E $\frac{1}{2}$ of Sec. 3, T. 33 N., R. 4 W., and in Sec. 2 adjoining, a little over a mile south of Pit River. The Sacramento Valley and Eastern Railroad, which connects with the main line of the Southern Pacific Railroad near the mouth of Pit River, passes along the north bank of the Pit here, making this deposit the nearest to transportation. It stands several hundred feet above the river.

Estate of D. P. Doak owns the SE $\frac{1}{4}$ of Sec. 23, T. 34 N., R. 4 W., largely covered by limestone, and lying one-fourth to one-half mile southeast of the United States fish hatchery. This is a large body, conveniently situated and about two miles north of the Sacramento Valley and Eastern Railroad. Adjacent to it, Shasta Iron Company operated a limestone quarry on the south end of deposit in Sec. 26 for years.

Moxley Deposit. Cora Lee Moxley, owner. This comprises all of fractional Sec. 13, T. 34 N., R. 4 W., containing 622 acres. Practically all of the section except part of the southeast quarter is covered by limestone as mapped by the U. S. Geological Survey, culminating in a mountain 3114 feet high. It is 2 $\frac{1}{2}$ miles north of the Sacramento Valley and Eastern Railroad. The lower, western part of this immense deposit is owned by Shasta Cement Materials Company. The contact of limestone on the west with quartz-augite-diorite is at about 1500 feet elevation, and about 700 feet above and one-half mile east of McCloud River, so it can be seen that by starting a quarry on the west edge of deposit, backs of 1600 feet would ultimately be had. Estimating average backs of 1000 feet for one-half the area, the immense total of over 1,000,000,000 tons of available limestone would be indicated. Actually the amount no doubt exceeds this.

The following is a reported analysis of limestone from the deposit:

Silica (SiO ₂)	1.10%
Iron oxide (Fe ₂ O ₃)	0.20%
Calcium oxide (CaO)	52.16%
Magnesium oxide (MgO)	2.38%
Aluminum oxide (Al ₂ O ₃)	0.24%
Ignition loss	43.96%
	100.04%
Indicated calcium carbonate	93.20%

This analysis agrees with quoted analyses from the quarry in Sec. 26, where large tonnages have been shipped over a period of years to smelters.

Between this property and the river there is a good plant site (see photo). The nearest sub-station from which electric power could be obtained is at Heroult, on Pit River about three miles south, where Noble Electric Steel Company formerly operated electric iron smelting furnaces. A large shale deposit covering parts of three sections lies $2\frac{1}{2}$ miles west and is conveniently located for cheap operation.

Shasta Cement Materials Association. M. E. Dittmar, Crocker Building, San Francisco, president. R. M. Saeltzer, Redding, secretary. The company owns 320 acres, unpatented, in Secs. 14 and 23, T. 34 N., R. 4 W., on which is found the western part of the large limestone deposit described under Moxley, and 320 acres, patented, in Sec. 16, T. 34 N., R. 4 W., where shale suitable for cement making occurs as well as limestone. A good plant site, between the first mentioned limestone beds and McCloud River, is also owned.

This property appears to be the logical starting place for the development of the limestone deposits nearby as it covers a frontage of a mile and a half from which work would be most conveniently begun. (See photo.) The limestone rises to a height of several hundred feet in the eastern part of Sec. 14, comprising the lower slopes of the limestone mountain. There is a large tonnage of stone available on the property.

The shale holdings in Sec. 16 have been estimated by M. E. Dittmar to contain about 200,000,000 tons of shale, and the following is an analysis of it reported to have been made by Smith, Emery and Company:

Silica (SiO_2)	57.51%
Iron oxide (Fe_2O_3)	8.28%
Calcium oxide (CaO)	2.98%
Magnesium oxide (MgO)	2.61%
Titanium oxide (TiO_2)	0.81%
Manganese oxide (Mn_2O_3)	1.34%
Aluminum oxide (Al_2O_3)	19.85%
Ignition loss	4.46%
Alkalies (by difference)	2.16%
	<hr/> 100.00%

Only assessment work has been done on the unpatented limestone claims and no work has been done on the shale, which was purchased in 1924 from the state.

Shasta Iron Company owns a large limestone deposit adjoining their iron mine in N $\frac{1}{2}$ of Sec. 26, T. 34 N., R. 4 W., $1\frac{3}{4}$ miles north of the Sacramento Valley and Eastern Railroad. This is the southern part of the deposit mentioned under Doak.

This limestone property is the only one in the district that has been developed commercially. A quarry face 200 feet long by 100 feet high was opened and limestone was shipped to Bully Hill for flux while the smelter was in operation. At present it is idle. This quarry was at the same elevation as the lower iron quarry, and the stone was delivered



The McCloud limestone deposits from the U. S. Fishery pond at Baird, Shasta County, California. Lower slopes on claims of Shasta Cement Materials Association. High mountain on left is the Moxley limestone property. Shows also other holdings. Photo by courtesy of M. E. Dittmar.

to railroad cars at Heroult over a gravity surface tram line 1600 feet long.

The following is an analysis of the limestone, quoted by Tucker:¹

Silica (SiO_2)	1.02%
Alumina (Al_2O_3)	0.61%
Magnesia (MgO)	1.12%
Calcium oxide (CaO)	53.80%
Iron oxide (FeO)	0.20%
Carbon dioxide (CO_2)	43.25%
	100.00%

Other Limestone Deposits.

Some small quarries have been operated in the past to supply the copper smelters with flux and to fill other local demands. Chief among these was the Holt & Gregg in Sec. 34, T. 34 N., R. 5 W., two miles northwest of Kennett, the railroad shipping point and smelter site. Lime was burned here for years for commercial uses and large amounts of limestone were also sold to the Keswick and Kennett smelters. With the closing and dismantling of both of these smelters, the principal local market is gone.

Another large limestone bed of same age as the last mentioned lies in Sec. 22, T. 34 N., R. 5 W., two to $2\frac{1}{2}$ miles west of the main line railroad, and a third and smaller deposit lies in Secs. 32 and 33, between Little Backbone and Squaw Creeks. These deposits (and a number of other smaller ones, which will not be listed because too remote from the railroad to compete with the above) are coral limestone of Devonian age, and differing from the McCloud beds. It is said to make good lime.

The following is a reported analysis of the Devonian limestone:²

Calcium carbonate	95.2%
Silica	4.4%
Magnesia	0.5%
Organic carbon	Trace

The Briggsville (Moorestown) Limestone Quarry is on Clear Creek, six miles by road west of Girvan, in $N\frac{1}{2}$ of Sec. 31, T. 31 N., R. 5 W. Years ago an old stone kiln using wood fuel was built here, but evidently little lime was burnt. J. H. Hill, Redding, re-located the property and in 1925 sold a few hundred tons of slacked lime for agricultural use.

A lens of limestone nearly 100 feet thick outcrops conveniently for quarrying on the slope near the roadside. The exact size of the deposit can not be judged because it dips into the hill and farther back is covered by overburden.

BIBLIOGRAPHY OF LIMESTONE DEPOSITS.

California State Mining Bureau publications: Reports IV, p. 112; VI, p. 98; VIII, p. 572; X, p. 627; XI, pp. 35, 37, 48; XII, p. 395; XIII, p. 632; XIV, p. 806; XVIII, p. 733; XIX, pp. 12, 69-71. Bulletin 38, pp. 88-91. Vol. 1 (Whitney Survey), Paleontology of California.

United States Geological Survey Publications: Bulletins 196, p. 94; 213, p. 365; 225, p. 176. Redding Folio, No. 138 (Redding Quadrangle maps and text).

¹ Cal. State Min. Bur. R. XVIII, p. 733.

² Cal. State Min. Bur. R. VIII, p. 572.



Limestone deposit and plant site of Shasta Cement Materials Association on McCloud River and in background, part of other limestone holdings. Photo by courtesy of M. E. Dittmar.

MANGANESE.

Low-grade manganese prospects were found on the *Pit River Consolidated* claims in Sec. 1, T. 33 N., R. 4 W., and Sec. 36, T. 34 N., R. 4 W., a mile southeast of Heroult smelter, and in the vicinity of the Peterson Group of claims. In 1917, Noble Electric Steel Company leased the claims and experimented with the material in the manufacture of silico-manganese, but found it unprofitable. The deposit consists of manganese oxide filling joint planes and cracks in schist, and carried 20% to 28% manganese, 23% to 37% silica and 6.7% iron.

Manganese prospects are also reported near Pit River in the vicinity of the Exposed Treasure Barite claims in the southwestern part of T. 36 N., R. 1 W. These are undeveloped.

Bibl: Cal. State Min. Bur. Bull 76, pp. 80-81.

MINERAL SPRINGS.

Big Bend Hot Springs are 65 miles northeast of Redding at Big Bend of Pit River, near Henderson Post Office. Hot water issues at several places for a distance of 350 yards along the south bank of the river. The warmest and largest of the springs has a temperature of 180° and a flow of about 25 gallons a minute. The water is hard, probably containing considerable calcium. The property was equipped as a small resort about 20 years ago.

Bumpass Hot Springs are on the south side of Lassen Peak about one mile northwest of the junction of the Tehama-Plumas and Shasta-Tehama County lines, and about three miles from craters opened during the eruptions in 1914. The hot springs in this region are a phase of the volcanic activity. The surrounding rock is said to have been altered to a white, siliceous material. The waters are in part acid and astringent and sulphur crystallizes around the vents.

Castle Crag Spring (Lower Soda Spring) is five miles south of Dunsmuir and a mile east of Sacramento River. The water is strongly alkaline-saline and deposits some iron. The principal constituents are sodium, calcium, magnesium, and high proportions of the carbonate and chloride radicles. A resort is maintained here.

Castle Rock Springs are near Sacramento River five miles west of south of Dunsmuir. The water is similar in general character to that of Castle Crag Spring but not so strongly mineralized. The water has been marketed for many years.

There are other cold carbonated springs on Soda Creek, 1½ miles above Castle Crag Spring, and near the river three-fourths of a mile south of Castle Rock Springs.

The lava beds of eastern and northeastern Shasta County receive a great deal of surface water which later issues as springs. Most interesting of these are the waters of *Burney Creek*, issuing only a short distance above Burney Falls; *Rising River*, 10 miles east of Burney; *Great Springs*, on Hat Creek on the north slope of Lassen Peak, and *Creek Springs* on the western side of Lassen Peak.

Kosk Creek Hot Springs are on the creek of the same name two miles north of Big Bend Hot Springs, and are similar to the latter, though smaller.

Soupan Hot Springs are $2\frac{1}{2}$ miles due west of Bumpass Hot Springs and the waters of the two groups are similar. Some small sulphur deposits occur nearby and have been prospected, but have never been commercially productive.

Bibl: U. S. Geol. Survey, W. S. P. 338, pp. 115, 116, 117, 140, 141, 224-227, 392.

MOLYBDENUM.

Molybdenite, the sulphide of molybdenum, occurs as disseminated flakes in quartz and granitoid rocks. It is soft enough to be scratched by the finger nail and is distinguished from graphite by the color of the streak, which is greenish gray.

In Shasta County it has been found in granite on Hazel Creek, also on Tom Neal Mountain. During the war, a deposit was opened on Boulder Creek near Gibson and a few tons of concentrate were produced by flotation.

Bibl: Cal. State Min. Bur. Bull 91, p. 32; Pre. Rept. 4, p. 23.

PLATINUM GROUP METALS.

Platinum, iridium and osmium have been produced in Shasta County as a by-product of gold dredging on Clear Creek and Cottonwood Creek, and by individual placer miners on Beegum Creek.

The subject was covered in our Bulletin No. 85, 'Platinum and Allied Metals in California.' The Beegum Creek region, and the prospects of platinum found there by the writer, were described in some detail, the conclusion having been reached by him after hand panning that a section of the creek bed would pay to mine. This was substantiated later by a number of miners who worked in the region for a year or so and made at times as much as \$20 a day apiece. The section of the stream worked was in the vicinity of Platina P. O. (Noble Station), in the extreme southwest corner of the county. Beegum Creek, a tributary of Cottonwood Creek, here forms the county line between Shasta and Tehama counties. The slate bedrock found here in places along the stream formed an ideal riffle which held the platinum swept down by erosion of serpentine and ancient shore conglomerate forming the surface of the watershed. While the platinum group metals have not yet been traced in California to any deposit in place, field work done for the above mentioned bulletin indicates that these metals came originally from areas of serpentine or basic igneous rocks from which serpentine is derived.

A small production of the metals was made as a by-product of gold dredging on Clear Creek. The Middle Fork of Cottonwood Creek was a more important producer and yielded most of the platinum group metals credited to the county. The principal operator here was Shasta Dredging Company. Platinum production became an important enough factor in the operations of this company to prolong the life of the field two years. Maximum production for the county was 219 ounces in 1921, but since then the above company has finished its ground and production at present is at the rate of only a few ounces annually.

Bibl: Cal. State Min. Bur. Bull. 85, pp. 38, 48-50; also annual statistical bulletins.

SAND, GRAVEL AND CRUSHED ROCK.

Inexhaustible supplies of sand and gravel suitable for use in concrete are available in Sacramento River and its tributaries. Two plants are operating on the river in and near Redding, and one on Clear Creek, one mile west of Girvan. Operation is intermittent.

Crews Plant. Phillip Crews, owner, 17 North Pine Street, Redding. Crews operates a small plant on Sacramento River about two miles east of Redding. River sand and gravel and crushed rock are supplied.

Diestelhorst Plant is on the south bank of Sacramento River within Redding city limits. Owner, Charles Diestelhorst, Redding.

Gravel and sand are dredged from the bed of Sacramento River with a drag-line bucket of $\frac{3}{4}$ cubic yard capacity and carried to the top of the washing and crushing plant. Sand and small gravel are washed and separated and coarse gravel is crushed in primary and reduction crushers. About 50% of the product is sand, which is quite coarse, and for this reason is preferred for highway construction. The plant capacity is 100 to 150 cubic yards a day. Steam is used for power, with crude oil for fuel. It is said to be more economical than electricity because of the irregular and intermittent operations, alternating with periods of idleness, during which latter periods payment for electric power would be required even when not used. A total of 100 h.p. is used.

Oaks Plant is on Clear Creek one mile west of Girvan. Owner, G. E. Oaks, 324 Yuba Street, Redding. Lessees, Savage Brothers, Redding.

Sand and gravel are dug from Clear Creek and elevated to the top of a small crushing and washing plant, where sand and fine gravel are washed and screened and coarser gravel is crushed. Gravel and crushed rock form two-thirds of total production. The capacity of the plant is 150 to 200 cubic yards and operation is seasonal and intermittent, being chiefly in summer and fall. Power is furnished by two Fordson tractors. The product is used largely in highway construction.

SILVER.

Silver Lodes of the South Fork Mining District, Shasta County.¹

BY W. BURLING TUCKER.

The South Fork Mining District is situated two and a half miles northwest of Igo, and fifteen miles southwest of Redding. The nearest shipping point is Girvan, twelve miles east on the Southern Pacific Railroad.

Topography.

The silver-bearing veins occur in a granitic batholith, which lies between the South Fork of Clear Creek, and Andrews Creek, and is about one and three-quarters miles through the base, along the trend of the main fissure systems, northeast and southwest. The elevations, as indicated by the U. S. Geological Survey, range from 1200 feet to approximately 2300 feet. The South Fork drainage empties into Clear Creek a few miles below the Chicago mine.

¹ This section on silver is reprint of an article by W. B. Tucker in our Report XVIII, pp. 313-321, 1922.

History.¹

Silver ore was first discovered in the South Fork Mining District in 1856. The Chicago mine, the principal producer of the district, was located in May, 1866, by N. S. and J. B. Batcheler. From 1866 to 1881 over \$100,000 worth of ore was taken out of this mine. The first shaft sunk on the Chicago mine yielded a handsome profit. The ore from this mine was mostly silver, although some taken from the original shaft ran as high as \$200 per ton in gold. Mr. C. N. Kingsbury, an Igo pioneer who worked in the mine in the early 70's, states that the mine was originally worked to a depth of 180 feet, when excessive water stopped operations.

The ore was hauled by wagon to Red Bluff, a distance of about forty miles, shipped by boat to San Francisco, then transhipped by sailing vessel to Swansea, Wales, for reduction. At a later period Mr. Butterfield operated the Chicago mine for a period of four years, and while the metallurgical losses were heavy with the crude practice then available, it is reported that a good profit was made from the mine. During these operations a steam pump was installed and the ore worked in a fifteen-stamp mill, which was located on the South Fork of Clear Creek. Amalgamation was not successful, and concentration was very faulty because of sliming of gray copper sulphides with which the high-grade silver was associated.

In the final operations a depth of 210 feet was reached in the Chicago shaft. Leasers worked the Chicago mine until late in the nineties, but increasing costs of operating at greater depth with crude equipment, and the fall in price of silver finally resulted in the discontinuance of operations. Before this time Mr. William Irelan, Jr., former State Mineralogist of California, became interested in the property. The drifting done on the Chicago lode was evidently considerable, but there is no reliable information as to the actual extent. It was evidently stoped to surface from the stated depth of 210 feet, a distance of about 400 feet southwest of the shaft. According to Mr. Alex Leiter, who was the pioneer Wells Fargo agent at Igo during the entire period that the Chicago mine was an active producer, the output was approximately \$1,000,000. In 1900 the present long drainage tunnel on the Silver Falls and Chicago Consolidated group of mines was driven into the mountain 3000 feet. This tunnel was driven by the Igo Development Company, and cost \$120,000. The burning of the plant, death of the managing director, and low price of silver caused the company to suspend operations.

Another property in the district worked in the early seventies and eighties was the Big Falls mine, operated by Mr. Ed. Ballou, now known as the Ballou mine. Here the values were mostly gold.

On Andrews Creek, three miles from Igo, is situated the Crystal mine, formerly owned and operated by H. Rothwell, first located in 1866. It is stated that ore shipped from this property ran from \$100 to \$300 per ton in silver, with low gold values. This property is now known as the White Star Group of mines.

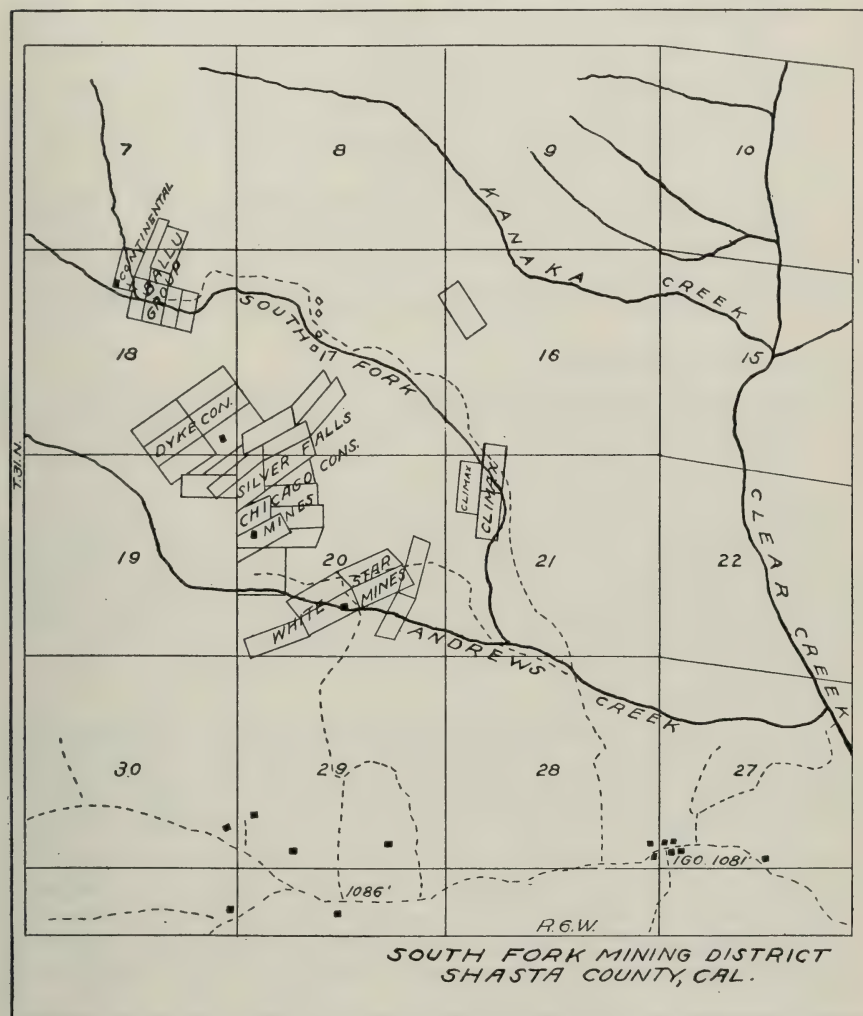
Big Dyke mine, situated north of the Chicago Consolidated mines, was discovered in 1866, and next to the Chicago and Crystal mines was the largest producer in the camp. It is stated that ore shipped from

¹ M. E. Dittmar, E. M., Crocker Bldg., San Francisco.

this property ran from \$100 to \$600 per ton. Acquired by William Dyke and Richter Bros. in 1906. Operated at intervals from 1906 until 1919.

Geology.

O. H. Hershey records the formations, in which the fault fissures occur as batholithic in character. He describes the country rock as



light-gray, medium-textured crystalline, consisting of white feldspar, colorless quartz, dark-green hornblende and dark-brown biotite, and probably a granodiorite. There is a finer-grained phase, possible gneissic inclusions, dark-gray basic segregations and small dikes of pegmatite and aplite. The rock constitutes a fairly large batholith and as the veins all have more or less vertical dips, they may be depended to continue in this granite mass. The veins occupy fissures in the

granite. The mountain, according to George Bancroft, is a batholith of quartz-hornblende diorite. J. S. Diller, in Redding Folio, maps the nearby areas of like formation, also as quartz-hornblende diorite and makes note of the batholithic structure.

The granodiorite is traversed by a system of northeast and southwest fissures, roughly parallel. Bancroft recognized two sets of veins, one striking N. 45° E., the other N. 58° E. The dip is generally to southeast at high angles. Near the surface some of these veins show a slight dip to the north, but the average dip is from 75° to 80° southeast. Both walls of the veins have heavy gouge showing some fault movement. The silver-bearing mineral is tetrahedrite, associated with galena, small amounts of pyrite, sphalerite and some chalcopyrite, with small amounts of gold. These roughly parallel quartz veins intersect at small angles, both in strike and dip.

Enrichment has occurred above intersections on the dip, where the convergence points upward. This is illustrated on the map of the Chicago workings, showing different veins and their intersections. The width of the veins varies from 8 to 4 feet. The zone of oxidation is from 10 to 50 feet in depth. Trend of ore shoots is to the northeast.

Water, Timber and Power.

Water and timber are plentiful for mining operations. The Pacific Gas and Electric Company's power line passes within three miles of the district.

Conclusions.

With intelligent development to determine the ore shoots that occur on the intersections of the different vein systems, both on strike and dip, and their general trend, the South Fork Mining District should develop a prominent silver producing area. The principal lack at present is a small flotation plant for treatment of the ores.

Acknowledgments.

The writer wishes to acknowledge the uniform courtesy extended him by owners and operators of mines in the district, and particularly the personal assistance in the field rendered by Dr. F. M. Archer and Chas. Dozier of Redding, and Arch Wright and Albert Kingsbury of Igo.

Big Dyke Mine. It is situated 4 miles northwest of Igo, in Secs. 17, 18, 19 and 20, T. 31 N., R. 6 W., adjoining the Chicago Consolidated Mines Company's property on the north. The property is owned by William Dyke, John and Frank Richter of Igo, California. There are six contiguous lode claims totaling 120 acres; known as the Big Dyke Group.

Claims: Edna, Little Dyke, Alta, Helen, Dyke Extension and Big Dyke.

Development has been confined to the Big Dyke vein on the Big Dyke claim.

A series of roughly parallel veins in the granodiorite, strike N. 60° E., and dip slightly to the southeast from the vertical. The Big Dyke fissure is about 3 feet in width with a filling of quartz and altered granite having heavy gouge on both walls. This filling is heavily

mineralized with argentiferous galena, tetrahedrite, some pyrite, sphalerite, some native silver and a small amount of gold. The veins are oxidized and leached to a depth of 20 to 50 feet.

Developments: At an elevation of 2000 feet a vertical shaft was sunk to a depth of 153 feet on the vein. On the 100-foot level the vein was drifted on 165 feet to the northeast, and 20 feet to the southwest. Some stoping was done on the ore shoot on this level, and a shipment made to the Mammoth Smelter at Kennett is said to have averaged 300 ozs. of silver per ton. About 50 feet below this level a drift was run 65 feet northeast on the vein. About 100 feet below the collar of the shaft there is a crosscut tunnel 200 feet long which intersects the vein on the 100-foot level, 100 feet northeast of the shaft. Southwest of the shaft a tunnel, now caved, was driven 200 feet on the vein. It is reported that the ore in the shaft has a width of 12 to 36 inches; assays range from \$20 to \$400 per ton.

Equipment: 15-h.p. gasoline hoist, 20-h.p. air compressor and pumps. Idle.

Climax Mine is situated three miles northwest of Igo, on the South Fork of Clear Creek, in Secs. 16 and 21, T. 31 N., R. 6 W., elevation 1200 feet.

Holdings consist of three claims, known as Climax, South Climax, and West Climax, totaling 60 acres. The occurrence of the veins on the Climax group of mines is somewhat different than the main northeast and southwest fissures that occur in the granite batholith in the South Fork mining district, as the principal vein developed on the Climax group of claims occurs on the contact of the granite and meta-andesite. The granite is the footwall and meta-andesite the hanging wall of the vein. The general strike of the contact is N. 10° E., dip 50° east. No prospecting or development work has been attempted to date to determine the possibility of finding ore on the intersection of the northeast and southwest veins with the contact and this point is worthy of investigation. The vein which occurs on the contact is a black carbonized slate cut by numerous stringers of quartz, and in places this carbonized vein material is replaced by quartz.

The enclosed vein material is mineralized with pyrite, chalcopyrite, small amounts of galena, and some sphalerite. About eighty feet west of the contact, a vein of quartz occurs in the granite, having the same general strike and dip as the vein on the contact. Two hundred feet west of the Climax shaft is another system of quartz veins in the granite. One strikes N. 40° E., and dips 80° east, the other strikes N. 20° E. and dips 70° east. Average width of veins is 4 feet.

These two veins intersect the contact north of the Climax shaft. The vein quartz shows the presence of silver chlorides and some galena. On the Climax claim, a shaft has been sunk to depth of 150 feet on a vein in the granite running parallel to the main contact vein. On the 100-foot level, a drift has been driven south 50 feet and north 40 feet on the vein, developing a lenticular shoot of ore fifty feet in length, width of ore being from 12 inches to 2 feet. The vein pinched below this level, and the shaft was sunk in the granite footwall to the 150-foot level. On this level a crosscut has been driven east 75 feet cutting the contact vein which has a width of 10 feet.

Vein material is black carbonized slate, containing numerous stringers of quartz. South of the Climax shaft about 150 feet, there is an incline shaft, 75 feet deep on the contact vein, which has been stoped to the surface north and south of this shaft for a distance of 100 feet.

The Black Prince shaft is 150 feet south of these workings, and was sunk to a vertical depth of 110 feet. The shaft started on the contact vein, but a short distance below the collar cut through the vein and passed into the granite footwall.

On the 100-foot level a crosscut was driven east to the vein on the contact, where it is reported to have a width of 10 to 20 feet. The average value of the ore extracted from this vein is reported to have been \$10 per ton in gold and silver.

On the South Climax claim there is a shaft 33 feet deep, which cut the vein on the contact. The vein quartz carries native silver, tetrahedrite, sphalerite, chalcopyrite, pyrite, and some gold mostly associated with the pyrite. A shipment of ore from the Climax shaft was made to the Selby Smelter in 1922, amounting to 4210 pounds, which assayed 0.08 ounces gold, 214.9 ounces silver, 6.6 per cent lead, and 25.2 per cent zinc.

Mine equipment consists of 9-h.p. gasoline hoist, 6"x4½" Gardner compressor, driven by 15-h.p. Fairbanks-Morse gas engine, blacksmith shop, air drills, and assay office.

Two men are employed. Owner: W. W. Robinson of Redding; Louis Davidson, superintendent.

Continental Mine. It is 6 miles northwest of Igo, on the South Fork of Clear Creek, at an elevation of 2200 feet. Holdings consist of 7 claims, in Secs. 7 and 18, T. 31 N., R. 6 W., and adjoin the Ballou Group of claims, on the west. There are two veins on this property, one which strikes N. 10° E., the other striking N. 45° E., and dipping 80° SE. Country rock is granodiorite. On the slope of the ridge north of the South Fork of Clear Creek, a crosscut tunnel has been driven N. 50° W., intersecting the vein, which has a course of N. 45° E. The vein has been drifted on 200 feet northeast. This vein is 8 inches to 3 feet wide and the fissure is filled with quartz and altered granodiorite, with gouge on both walls. The fissure is heavily mineralized with argentiferous galena, pyrite, tetrahedrite, sphalerite, and native silver, and carries a small amount of gold. The vein is oxidized and leached to a depth of 20 to 50 feet. This tunnel gives a depth of 200 feet vertically below the outcrop. Near the top of the ridge, about fifty feet below the outcrop, a tunnel was driven on the vein, extent not known and now caved, but probably 200 feet. At the mouth of the tunnel there is a shaft. On the surface the outcrop of quartz is 8 to 10 feet wide and can be traced for at least 3000 feet. In the eighties the operators had a 6-stamp mill on the South Fork, where ore was milled from these upper workings. Equipment consists of cars, track and blacksmith shop. Property idle. Only assessment work done. Owners: V. V. Apperson and associates of Willows, California.

Manzanita Mine. (Ballou Group of Mines.) This group of mines is situated 6 miles northwest of Igo, in Secs. 7 and 18, T. 31 N., R. 6 W. The workings are on the north slope of the ridge, northeast of the South Fork of Clear Creek, at an elevation of 2300 feet. Holdings

consist of 5 claims, namely: Hope, Sulphide, Manzanita, Greater Falls Series, Plus Series, all held under U. S. mineral patents, totaling 100 acres. The property is owned by May V. Ballou of Redding, California. These claims were located December 13, 1880. A series of parallel quartz veins, whose general strike is N. 20° E., and dip 80° E., traverse the granodiorite. On the Manzanita claim, at an elevation of 2300 feet, a crosscut tunnel was driven 30 feet west, cutting a vein which strikes N. 20° E. This vein was drifted on to the south 200 feet. The vein has a width of 8 inches to 2 feet, but the pay ore occurs in a seam of oxidized quartz near the footwall that is heavily stained with iron. This seam carried high gold values. The quartz carries gold, and some pyrite. This tunnel is only about 75 feet below the surface and in the oxidized zone and probably with greater depth one may expect to encounter silver-bearing ores, as in the rest of the district.

There are seven tunnels and one shaft on the property. Tunnel on the Hope claim is 700 feet long. On the Sulphide claim there is a tunnel 300 feet in length, besides a number of shorter tunnels, from 50 to 100 feet in length.

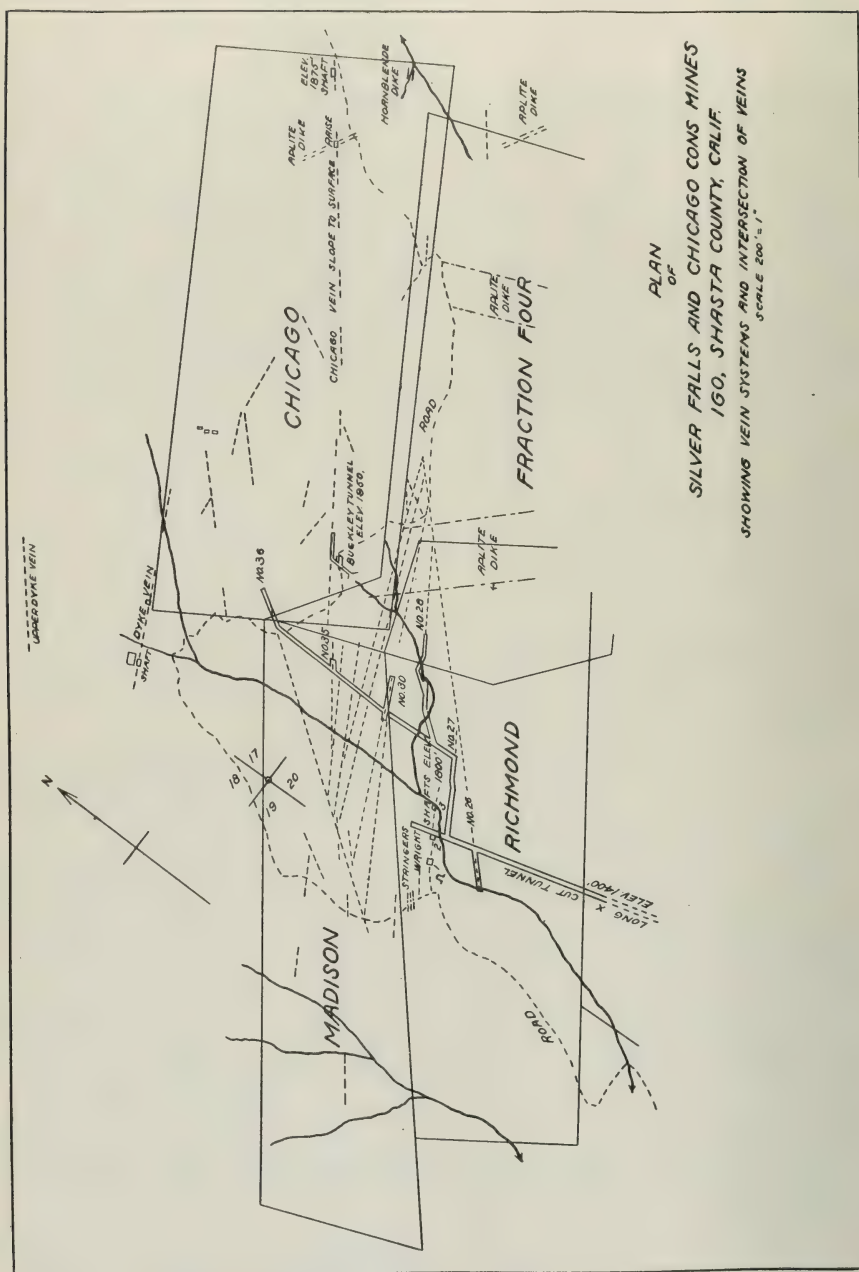
George Z. Bertchy of Oakland was preparing March, 1926, to begin work on the claims. A small mill was being hauled to the property.

The Silver Falls-Chicago Consolidated Mines group has been the most important mine in the district. It is 4 miles northwest of Igo. The present works are in Secs. 17, 18, 19, 20, T. 31 N., R. 7 W., on the southwestern slope of the mountain, at an elevation of 1400 feet. The property is owned by Mrs. Clara Archer of Redding, California. Holdings consist of the following claims: Pillchunck, Union Cold Spring, Richmond, Madison, and Chicago, held under U. S. mineral patents; Fraction No. 1, Fraction No. 2, Fraction No. 4, Metal, Amy and Batholith, by location, totaling 220 acres.

Developments consist of the main Chicago shaft which was sunk to a depth of 210 feet on the Chicago-Madison vein, and stoped to the surface 400 feet southwest of the shaft. Production from these workings was approximately \$1,000,000.

On the Richmond claim, 3 shafts, known as the Wright shafts, were sunk on the Richmond lode system. No. 1 shaft is 30 feet deep; 40 feet northeast of this shaft is No. 2 shaft which was sunk to a depth of 80 feet; and 60 feet northeast of the latter is No. 3, having a depth of 20 feet. A drift was driven from No. 1 shaft to No. 2. The vein in these workings is said to be from 10 inches to 2 feet wide. When work was suspended in No. 2 it is reported that there was 12 to 18 inches of good ore in the bottom. Ore mined from these workings was sorted up to 400 ozs. silver per ton and shipped. Samples taken from ore in place along the strike of the vein between these shafts ran from 10 ozs. to 163 ozs. in silver per ton. The ore shoot is 120 feet long, average width 12 inches. These shafts are approximately 2150 feet north of the portal of the main crosscut tunnel, the surface being 540 feet above the tunnel level.

At the southwest end of the Chicago claim a crosscut tunnel was driven 50 feet, cutting the main Chicago-Madison vein, and a drift run northeast 75 feet and stoped out to the surface. The vein is 12 inches to 2 feet wide, carries high values in gold, and samples taken from the



face of the drift ran \$26 per ton in gold. These workings are 550 feet above the tunnel level. In 1900 a crosscut tunnel was driven 3000 feet in the mountain, at an elevation of 1400 feet, giving a depth of 600 feet below the outcrop of the Chicago vein. This tunnel cut 36 fissure veins as identified and mapped by George Bancroft. Quite a number of these veins are little more than seams or fractures in the granite. The most prominent may be classified as the Pillchunck, Union, Cold Spring, Richmond and Chicago-Madison lode systems. The Pillchunck, cut in the tunnel at a depth below the surface of 261 feet, was the first vein of any consequence. A drift was driven on this vein about 100 feet northeast, but not driven far enough to cut the ore shoot developed on the surface. The vein shows some quartz with heavy gouge on both walls. Further in the mountain the Union vein system was cut 384 feet below the surface. The next exposure of importance is on veins 26 and 27. The crosscut here obtains a depth of 540 feet vertically below the surface and then extends northeasterly 200 feet as a drift on 27. The tunnel then turns due north and is continued as a crosscut 600 feet farther to what is known as vein No. 36, which was drifted on 100 feet.

Vein No. 28, which was cut in this crosscut, was drifted on northeast 225 feet. In this drift a shoot of ore was developed having a length of 210 feet, the vein averaging 12 inches in width. Ore stoped about 20 feet above drift. Shipment made from this stope in February, 1910, to the Mammoth Smelter, without sorting, assayed 17.7 ozs. ag. and \$0.83 in gold. Shipment included all vein matter between walls in the five-foot fissure. Veins No. 30 and No. 35 were drifted on only a short distance. No. 35 is evidently the main Chicago-Madison lode, although it may be vein No. 30. This system apparently includes veins 28 and 30 intersecting on the northeasterly strike. Vein No. 30 intersects veins 35 and 36 several hundred feet from the tunnel on the southwesterly strike. The intersection of the veins on both strike and dip is important in forming ore shoots. Ore shoots form in lenticular masses of quartz, varying in width from 10 inches to 4 feet.

In October, 1922, California Bi-Metallic Corporation of Santa Barbara began active development of the property under lease and option to purchase. They employed a crew of 25 men and installed some equipment. They did over 1400 feet of new development.

In the main tunnel 500 feet from the portal, they drifted on the Pillchunck vein over 270 feet northeast and 50 feet southwest. The vein in southwest drift was said to assay well and to show three feet of mineralized quartz. A raise was also put up on No. 28 vein at the intersection of crosscut No. 36, and the drift on this vein was extended several hundred feet northeast. At about 380 feet from the raise a rich shoot is said to have been found, showing from eight inches to two feet of quartz, that assayed high in silver and gold. The main crosscut was extended 190 feet to vein 36. A crosscut was run south from No. 27 drift 30 feet to vein 26, which was drifted on northeast for 120 feet.

In the Buckley tunnel on the main Chicago-Madison lode, 40 feet was drifted and other work was started. The company has since quit work and the property is idle.

Equipment includes a 12" by 12" compressor, 50 h.p. gas engine, blower, 10 h.p. gas engine, drill sharpener, 6 air drills and 12 ore cars.

There are two bunk houses, assay office, compressor house, shop, office and residence.

Bibl: Cal. State Min. Bur. R. XVIII, pp. 316-318; R. XIX, p. 13.

White Star Silver Group of Mines (formerly known as Crystal Mine). It is situated three miles northwest of Igo, on Andrews Creek, at an elevation of 1250 feet. The property is owned by Thomas Kingsbury, Albert Kingsbury and J. D. Hubbard of Igo, California. Holdings consist of the following claims: J. D., White Star, North Star, Wood, Contact, Contact Fraction, Henry Ford and Henry Ford Extension, totalling 160 acres. These claims are located in Sec. 20, T. 31 N., R. 6 W.

Three parallel veins cut the granodiorite, and are about 20 to 40 feet apart. Strike northeast, dip 80° southeast. The ore carries native silver, tetrahedrite, sphalerite, small amount of pyrite, chalcopyrite, and some gold associated mostly with the pyrite.

Developments: Outside of a number of prospect shafts and short tunnels, all work has been confined to the middle vein. A crosscut tunnel has been driven N. 50° W., 320 feet, which cut the three veins at a depth of 90 feet below the surface. No. 1 vein was cut 150 feet from the portal of the tunnel, and drift run 50 feet to the northeast and 35 feet to the southwest, and was stoped about 15 feet above the drifts. Vein has a width of 12 inches to 3 feet. Twenty feet farther on it cut No. 2 vein, which was drifted on 100 feet to the southwest, and 60 feet to the northeast. On this level, 20 feet to the southwest, a raise was run to the surface on ore. The ore extracted from this raise is said to have carried high gold values, and it was stoped to the surface. In the northeast drift on this vein, at a distance of 40 feet from the crosscut tunnel, a raise was made for 40 feet, then the vein was drifted on 40 feet to the southwest and connected with the shaft from the surface. The main crosscut tunnel continues 160 feet, where it cut No. 3 vein, which has a width of 2 feet, but no development has been done on this vein. At 10 feet northeast of the main crosscut tunnel, a winze has been sunk 50 feet and a drift driven on the vein 100 feet northeast. No. 1 and No. 2 veins intersect northeast of the winze on this level forming an ore shoot 60 feet in length. Width of the vein is from 2 to 5 feet.

A shipment of ore made from this shoot to the Selby Smelter on April 27, 1922, ran 150 ozs. in silver, 0.2 oz. gold, 1.8% lead, and 13.3% zinc.

The property has been operated off and on by Mr. Albert Kingsbury, who has shipped about \$2,000 worth of ore to smelters. The general run of ore from this mine will average from \$10 to \$50 per ton.

Equipment: Consists of cars, handpump, blacksmith shop and tools. Development work in progress.

TALC.

At the property of Ganim Gold Mines Company in Sees. 5, 8, and 15, T. 32 N., R. 6 W., $2\frac{1}{2}$ miles northwest of Whiskeytown, a deposit of good grade white-grinding talc has lately been developed. Redding, the nearest railroad point, is 13 miles east by good road.

An adit 900 feet long, starting in an easterly direction, cuts the tale about 600 feet from the portal, and shows tale for a distance of about 50 feet. The body of tale is cut diagonally by the adit, both on the dip and strike, as the tale strikes N. 30° W. and dips about 45° SE. About 425 feet from the portal a drift runs north to northwest on a curving course, cutting the tale and being about on its strike for 50 feet at time of visit, March 17th. These openings show the presence of good-grade tale at points about 100 feet apart on the strike. At the northwest face the backs are about 100 feet, and good-grade tale has been found at the surface. Presuming the tale to be continuous on the dip to the surface, and on the strike between the points cut (although this has not been positively proved by raises or crosscuts) the amount is large.

The tale is of apparently uniform quality, free from grit and dark colored impurities where opened at time of visit. Reported analyses are as follows:

SiO ₂	60.75	61.90
Fe ₂ O ₃	0.88	0.65
Al ₂ O ₃	2.28	0.87
Lime	-----	-----
MgO	30.40	30.34
Ignition loss	5.73	-----
Titania	-----	-----
Moisture	-----	0.26
Combined water	-----	4.90
Alkalies by difference	-----	0.90
Mn ₂ O ₄	-----	0.18

Several carloads have been shipped during 1926.

L. R. Lehman, 811 South St., Redding, has submitted samples of tale to the Bureau from an undeveloped prospect 12 miles southwest of Redding, on the west side of Clear Creek. The samples contained a little iron oxide.

ZINC.

In the past few years zinc has become the principal product of the mines at Bully Hill and Ingot. Other mines in the copper belt, now idle, contain zinc sulphide associated with the copper ores, but are not known to carry such a high percentage of zinc as the Afterthought or Bully Hill mines. Electrolytic zinc was produced during the war both at the Mammoth plant at Kennett and at Winthrop. Much zinc has been lost in the past as the copper smelters were not equipped to save it. The flue dust saved in later years at the Kennett smelter, and remaining unworked up to the present time, contains a good deal of zinc, as well as other metals. Plans are now under way to treat this flue dust in a plant just erected at the smelter site, as mentioned farther on. Some zinc ore was shipped years ago from the Donkey Mine near Ingot. Lately some small prospects carrying zinc have been noted farther northeast of Ingot near the road to Montgomery Creek. These are not active.

Afterthought Mine. Operated by California Zinc Company. Main office, Winthrop, California. The property contains 1650 acres in Secs. 5, 10, 11, and 25, T. 33 N., R. 2 W., near Ingot, 24 to 25 miles

northeast of Redding. J. F. Dugan, General Manager. R. W. Adams, Superintendent.

The activities of Afterthought Copper Company terminated late in 1923 with the sale of the property under foreclosure to the Milliken interests. The California Zinc Company began work in February, 1925. The 300-ton flotation plant and the reverberatory furnace which were erected in 1918 by the former company and the entire reduction works at Ingot have been abandoned, partly dismantled and much of the machinery removed to Bully Hill or Winthrop.

A new aerial tram, $8\frac{1}{2}$ miles long has been built from the Afterthought to the company's plant at Winthrop. This tram carries 80 buckets of 850 pounds capacity each, at a speed of six miles per hour, so has a capacity of 288 tons per 24 hours. The longest span is 4700 feet. This tramway was put in operation in November, 1925, and at



Surface plant and tram terminal, Afterthought mine, near Ingot.

present is delivering about 75 tons a day to the flotation plant at Winthrop.

No increased depth has been reached, the bottom of the main shaft remaining at 800 feet, vertically. A new shaft has been raised from seventh to fourth level. Ore is being mined on several levels.

The ore occurs in shear zones in rhyolite near the contact of shale. Two roughly lens-shaped orebodies, called the Afterthought and Copper Hill lodes, strike northwest and dip 70° NE. During 1923 it was estimated that some 300,000 tons of ore were developed, carrying an average of 16% zinc, 3% copper, $5\frac{1}{2}$ ounces silver and 0.03 ounces gold per ton. The ore now being mined is stated to run about 18% zinc and $2\frac{1}{2}\%$ copper. It is finely disseminated, carrying sphalerite, pyrite, chalcopyrite, galena and bornite.

The profitable operation of the Afterthought has always been a difficult problem because of the complex nature of the ore. The sphalerite in the ore is a primary constituent of it, according to

Diller.* The attempts of the Afterthought Copper Company to produce separate zinc and copper concentrates by collective and selective flotation were not successful, as the two metals could not be cleanly separated. The "copper concentrate" carried 12% zinc and zinc "concentrate" 2.6% copper, so that a clean zinc product was not obtained for the furnace. The present treatment consists of making a bulk concentrate, dropping as much pyrite as possible, as described under Bully Hill Mine. Forty men are employed at the Afterthought.

Bully Hill Mine. Operated by California Zinc Company. Main Office, Winthrop, California. J. F. Dugan, general manager. The property is at and near Winthrop in Secs. 12, 16, 21 and 28, T. 34 N., R. 3 W., and is connected with S. P. Co.'s main line by Sacramento Valley and Eastern Railway, extending from Pit to Winthrop.

The eastern lode in the Bully Hill Mine and the Western Lode in the Rising Star (under the same ownership) are almost parallel and about 200 yards apart. They strike about N. 10° E. and dip nearly vertically and the ore shoots pitch steeply north. The ore is in lenses in shear zones in the rhyolite. A recent development, reported by the present operators, is the finding of small, hitherto unmentioned ore-bodies in a body of gypsum on the footwall side of the shear zone in the Rising Star Mine. This gypsum formation is about 200 feet wide and 700 feet long and extends up as far as the 700 level. All operations underground are confined to the Rising Star Mine, which is developed by adits, a shaft 1100 feet deep, and levels 100 feet apart. The shaft is sunk from the main adit level (No. 5) and work below here is being done on the 6th, 7th, 8th, 9th, and 10th levels. The present company has done no new shaft sinking but has opened the downward extension of the 900-level orebody. During the war this property as well as others in the county was worked with the idea of getting out the most copper in the shortest possible time and the Rising Star Mine is credited with a production of 27,000 tons of 6% copper ore in 1918. The zinc orebodies now being mined are the shells left from past operations, in large part. The orebodies vary in size from a few inches wide up to lenses as much as 30 feet wide and 100 feet long. The average ore carries 20 to 22% zinc, 1½ to 2% copper, 2 ounces silver and 60 cents gold per ton. The principal ore minerals contained are pyrite, chalcopyrite, sphalerite, and small quantities of galena, chalcocite and bornite. Barite and quartz are the principal gangue minerals.

Ore Treatment.

The later history of operations at Winthrop is like that at Ingot. A plant for the production of electrolytic zinc by electrolysis of zinc sulphate was operated by General Electric Company in 1915, and made some production. In 1917, Bully Hill Mining Company took the property and in addition to shipping selected copper ore, built a 150-ton flotation plant, which was not a success. In 1920, Daniel C. Jackling and others organized Shasta Zinc and Copper Company and began operations. During the few years preceding, a great deal of

* Diller, J. S., Redding Folio No. 138, U. S. Geological Survey.

development work had been done in the Rising Star Mine and it was estimated that 300,000 tons of ore had been blocked out. The new company proceeded to construct a reverberatory furnace and a zinc oxide plant, which was put in operation in June, 1922, and operated until December, 1922, when it was closed down, ostensibly because of the drop in the price of zinc oxide. The method of treatment consisted of preliminary roasting of fine ore mixed with coal dust and fluxes, in McDougall roasters, then smelting it in a reverberatory furnace, where copper matte was produced; gases containing zinc oxide (produced when the zinc sulphide ore was reduced, and volatilized zinc was re-oxidized) were passed through a series of large bags, where crude zinc oxide was recovered. This was treated in a refining furnace, and zinc oxide recovered a second time in another bag house. The plant had a capacity of 30 tons of zinc oxide and 20 tons of copper matte a day.



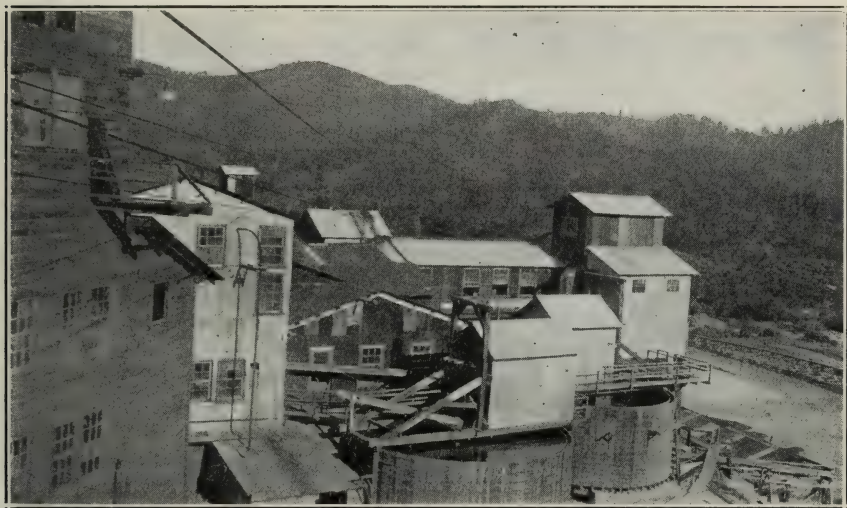
General view of plant of California Zinc Company at Winthrop, showing tram terminal and ore bins on left, concentrator and smelter.

Late in 1924, California Zinc Company took the property. They have abandoned the system of treatment described above and are at present employing oil flotation. The present product is a bulk concentrate containing zinc, copper, lead, gold and silver, which is shipped to Belgium for treatment. Experimental work is carried on, and some scheme of selective flotation may later be used. The system in use late in April, 1926, is outlined below, but a complete flow sheet is not shown as the operators state that minor changes are frequent.

About 75 tons of ore from the Afterthought aerial tram and 130 tons from the surface tram from Bully Hill are delivered daily to the coarse-ore bins. This contains an average of 16% to 22% zinc, 9% to 10% iron and 1.8% to 2.08% copper as well as a little galena, gold and silver. It is sent by belt conveyor to a gyratory crusher and to Garfield rolls, is screened to one-half inch on a vibrating screen, and fine ore is conveyed to fine-ore bins. It is fed from here to a belt conveyor by belt feed, and delivered to two Marcy mills in closed

circuit with Dorr classifiers. A 20% solution of copper sulphate is added at the head of the Dorr classifier overflow. Fine pulp goes to a steady-head tank and to a 16-cell Minerals Separation flotation machine. The froth product from first six cells is treated in a recleaner; froth from next four cells is returned to the head of the machine and from last six cells to cell No. 10. Reagents used are 0.15 lb. potassium xanthate, small quantities of 634 Barrett oil, water-gas tar and pine oil, as well as $6\frac{1}{2}$ lb. of lime per ton of ore. The lime alkalizes the pulp and makes it possible to drop about one-half of the pyrite.

The tailings from No. 1 flotation machine pass to a second set of 22 flotation cells. The froth (concentrate) from the first 9 or 10 of these cells is cleaned in two primary cleaners in series, and the froth from these goes to a recleaner, from which the finished product is taken. This is thickened in a Dorr thickener, filtered through an



Concentrating plant of California Zinc Company at Winthrop.

Oliver filter and taken by belt conveyor to railroad cars for shipment, or to bins. Tailings from the primary cleaners are returned to the head of No. 1 flotation machine, tailings from the recleaner to head of the primary cleaner, and tailings from end cells of No. 2 flotation machine go to waste, froth having been returned to head of machine.

The recovery is stated to be 90% to 96% of zinc, 85% to 86% of copper and 70% of silver. Concentrates contain 43% to 49% zinc, 3.7% to 4.1% copper, 7% to 11% iron, 1.3% to 1.7% lead and 2.3% silica, so that the concentration of valuable metals is a little better than 2:1.

About 100 men are employed at the Bully Hill Mine and at Winthrop.

Old Glory Group of five claims is $5\frac{1}{2}$ miles northeast of Ingot on the opposite side of the highway from the St. John prospect. Owners, B. F. Bibbens and H. C. Woodrum, Redding.

The rock is grey limestone, in which occur seams striking northwest which carry galena, and another system of seams striking nearer north carry zincblende. The Old Glory claim is said to show a fair prospect of zincblende, while on the Highway Claim a vein three feet wide at a depth of 10 feet is reported to assay well in lead at points 300 feet apart. Only assessment work has been done by the present owners, including the reopening of an old adit 200 feet long on Highway claim.

Pacific Mineral Corporation. F. M. Ball, 112 Market Street, San Francisco and Fred Grotefend, Kennett, have lately installed a 60-ton plant at Kennett for testing the Elliott Process upon the accumulation of flue dust at the Mammoth smelter. The plant had not been completed at the time of visit, but a trial run has since been made and is reported successful. The process is one patented by Alexander Elliott and while full details have not been given out, it is a wet chemical treatment, using lime, sulphur and iron. The plant consists essentially of an ore bin, 20-ton Pachuca tank, several large redwood tanks divided into 11 separate compartments, and a small furnace for calcining. The first step is the removal of copper by solution with acid, which is provided by sulphide ore or concentrate, which also provides the iron. It is claimed that removal of copper is so complete that it is possible to produce next a very high-grade zinc oxide, which is pure white after calcining. Grotefend claims that the time for treatment is only three hours, and that two-per-cent copper ore can be profitably worked. The cost per pound of copper would be only a fraction of that by other methods.

There is estimated to be about 20,000 tons of flue dust at Kennett, which contains copper, zinc, gold, silver, lead, antimony, cadmium and sulphur. The owners had previously tried many methods for working this, but without success, although it is said to be worth considerably over \$20 a ton. Should the Elliott Process prove commercially applicable, its importance to Shasta County will be much farther reaching than the mere recovery of the above locked-up metals, as there are large tonnages of low-grade copper and copper-zinc ores available, which are too low grade to smelt, but could be made to yield a profit by a cheaper process. The location of the new plant on the railroad in the heart of the copper mining district is advantageous, and the preliminary tests are being watched with great interest locally.

St. John Prospect is $5\frac{1}{2}$ miles northeast of Ingot by road, in SE $\frac{1}{4}$ of SE $\frac{1}{4}$ of Sec. 30, T. 34 N., R. 1 W. Mrs. C. E. Eilers, Ingot, is the owner and claim is leased to E. Cartwright of Ingot.

An orebody 8 feet by 60 feet outcrops on the claim just east of the state highway. It has been prospected on the surface. The ore is mostly brown zincblende, with a little galena and copper sulphides. The ore appears as an irregular mass and stringers in grey limestone, and picked samples yielded 19% zinc. A few tons have been hauled away and milled by Cartwright. The Washington claim across the road shows a lead prospect. No work was being done in April, 1926.

SAN FRANCISCO FIELD DIVISION.

C. McK. LAIZURE, Mining Engineer.

SAN BENITO COUNTY.

Introduction.

On February 12, 1874, that portion of Monterey County lying north and east of the Gabilan Mountains was separately organized as San Benito County.¹ The eastern boundary of this new county was originally an irregular line following the summit of the Diablo Range, which had likewise served as the former boundary of Monterey County since 1850. The area of San Benito County, however, was increased considerably in 1887 by changing the irregular eastern boundary along the summit of the Coast Range to straight lines based on the United States surveys which took in portions of western Fresno and Merced counties. With this change in 1887 its area and outline became practically the same as they are today.

Geography.

San Benito is one of the central counties situated between Monterey, a coast county, which adjoins it on the south and west and Merced and Fresno, two of the great San Joaquin Valley counties, which bound it on the northeast. Santa Clara County and a corner of Santa Cruz adjoin on the north.

The county extends southeasterly from Pajaro River for 70 miles with an average width of 20 miles. Its area is 1392 square miles and the population, most of whom reside in or near the few towns along the railroad in the northern part, is 8995 (1920 census).

About one-fourth of the county is government land. Most of the remainder was long held in the form of large land grants and immense ranchos. As may be expected, cattle-raising early became an important industry and it still is of prime importance. In later years some of these ranchos have evolved into fruit orchards and small farms due to irrigation and intensive cultivation of the valley lands. As a result, fruits and vegetables, dairy and poultry products, as well as hay, grain, and live stock have become important sources of wealth. Mining has been carried on since 1858, the total recorded mineral production to date approximating \$30,000,000.

Transportation facilities are limited. There is a branch of the Southern Pacific railroad from Gilroy, via Hollister, the county seat, to Tres Pinos. The main coast line of the Southern Pacific also touches the county at Logan, after passing through Pajaro Gap. The 'California Central,' a line 8 miles in length connects Old Mission Portland Cement Company's plant with the Southern Pacific at Chittenden. Other parts of the county are served by auto stages from Hollister and Tres Pinos. The southern section can be reached equally as well through Coalinga or Mendota on the San Joaquin Valley side or from King City and San Lucas on the west. Excellent highways join Hollister with Merced on the valley highway route and with San Juan Bautista on the coast route of the state highway system. The road to the interior is by way of Pacheco Pass.

Topography.

The famous Santa Clara Valley penetrates the northern end of the county as far as Hollister. From this point the narrow valley of San

¹ Coy, Owen C., California County Boundaries, California Historical Survey Commission, Berkeley, 1923.

Benito River continues southeasterly to the southern boundary. This river and its chief tributary, Tres Pinos Creek, with many smaller streams flowing in from east and west practically drain the entire area. Numerous smaller mountain valleys are found along the flanks of the two ranges of the Coast system, which roughly parallel one another and dominate the topography. The mountains on the western side are known as the Gabilan Range, the peaks of which range from 3000 to 3500 feet in elevation. The Diablo Range on the east rises in many of its peaks to elevations of nearly 5000 feet. In the southeastern corner of the county, east of the summit of the latter range, Panoche and Silver creeks drain a small area which is a portion of the San Joaquin watershed.

Geology.

There is considerable literature on the geology of portions of San Benito County but most of the detailed geologic studies have been confined to those sections considered to be possible oil-bearing territory or to the quicksilver mining districts, and no single geologic report fully covers the county. The reader who is primarily interested in the geology should refer to the publications listed in the bibliography.

The general geology as shown on the geologic map of California published by the State Mining Bureau in 1916 is briefly outlined in the following paragraphs.

The Gabilan Range on the western side is composed of ancient granitic rocks associated with crystalline schists and limestones. Dolomite and more rarely barite deposits occur with the limestone and have been developed from San Juan Bautista southerly to Cienega Valley. Farther south in a small area surrounding the Pinnacles National Monument which in itself is an example of intense vulcanism, fine-grained volcanic rocks occur. In the southwestern portion of the county from Topo Valley south and east to San Benito River the formations exposed are sedimentary rocks of Tertiary age which include numerous gypsum beds, some bituminous sandstones and diatomaceous earth.

On the northeastern side of the river the Diablo Range rises abruptly and from near Hernandez south and east beyond San Carlos Peak it is made up of Franciscan rocks chiefly serpentine but with much red chert, sandstone, slate and schist near the river. From Idria northwesterly nearly to Llanada, Cretaceous and Tertiary rocks make up the main range. From Llanada northward to the northern end of the county the Diablo Range is typical of the Coast Mountains, consisting of serpentine, chert, metamorphic sandstone, slate and schist. Quaternary and late Tertiary sediments comprise the valley area surrounding Hollister and sandstone, shales, sands, gravels and clays are much in evidence along San Benito River as far south as Hernandez.

San Andreas fault, a dominant structural feature of the geology, enters the county near Chittenden and runs southeasterly along San Benito River as far as the town of San Benito. From here it crosses a low divide into Rabbit Valley and from there it follows Bitterwater Creek to its junction with Lewis Creek and then continues southward up Lewis Creek.

Mineral Resources.

An extensive and diversified number of mineral substances are found in San Benito County. Both metallic and nonmetallic minerals are included in its resources, but commercial production has been limited,

and many deposits have remained entirely undeveloped on account of their distance from railroad transportation. Neglect of mining opportunities may also be due in part to the fact that many deposits are on private lands whose owners are interested in other lines of activity.

Quicksilver production has given San Benito its reputation in the mining world, as it ranks among the oldest and most important quicksilver producing counties. The New Idria mine, in the southern part, is the largest single producer of quicksilver in the state. Since 1918, however, the value of the county's annual output of quicksilver has been exceeded by that of cement. Crushed rock production closely follows quicksilver in annual value of output. Other mineral products which have been produced in greater or lesser amounts are: antimony, asbestos, asphalt, bituminous rock, brick, chromite, coal, dolomite, gems, gypsum, lime, and limestone, magnesite, manganese, and mineral water.

Barite, clay, copper, diatomaceous earth, feldspar, gold, iron, montmorillonite, petroleum, strontium and volcanic ash also occur here but the commercial value of these deposits is not as yet established. A number of other mineral species are represented in the county but their occurrence is of mineralogical interest only.

The last full report on San Benito County was published in State Mineralogist's Report XV, 1915-16. Some additional notes were contained in the monthly chapter of Report XVIII, MINING IN CALIFORNIA, May, 1922. In 1918, Bulletin No. 78, 'Quicksilver Resources of California,' was issued. This bulletin covered all quicksilver districts in the state and contains a detailed description of the mines and reduction plants in San Benito County. The occurrences of chromite and manganese are discussed in Bulletin No. 76, 1918. Bulletin No. 79, 'Magnesite in California,' 1925, includes descriptions of the magnesite mines in this area. The possibilities of oil production and the geology of much of the county are covered in detail in Bulletin No. 69, 'Petroleum Industry of California,' 1914, (out of print) and in Bulletin No. 89, 'Petroleum Resources of California,' 1921 (out of print). Earlier reports and bulletins describe many other occurrences of minerals of possible economic value.

In order that these notes might conform to the new series of county reports begun in State Mineralogist's Report XXI, MINING IN CALIFORNIA, January, 1925, and continued in quarterly chapters thereafter, the county was visited in March, 1926, for the purpose of bringing all available data up to date. While an endeavor has been made to make this report as complete as practical, due to the short time allotted for field work, detailed descriptions of the mines and properties have been omitted, in cases where they have been sufficiently covered in former reports.

The writer wishes to acknowledge the uniform courtesy of mine operators and owners of mineral deposits, and particularly the personal assistance rendered by Mr. H. V. Underwood, Sunnyvale Road, Hollister. Mr. Underwood has been active in prospecting many deposits, particularly of the nonmetallic minerals, and he is exceptionally well acquainted with the county's undeveloped mineral resources.

San Benito is a county which might easily be overlooked in naming the 'mining counties' of the state, yet its mineral output in 1924 was valued at over two million dollars, and it ranked nineteenth among the fifty-eight counties of the state. The following table gives the total recorded production, which covers the period from 1865 to 1924, inclusive.

Year	Quicksilver		Lime		Gypsum	
	Flasks	Value	Barrels	Value	Tons	Value
1865.....	17,455	\$943,617				
1866.....	6,525	346,673				
1867.....	11,493	527,529				
1868.....	12,180	559,062				
1869.....	10,315	473,459				
1870.....	9,888	567,373				
1871.....	8,180	516,158				
1872.....	8,171	538,714				
1873.....	7,735	621,353				
1874.....	6,911	726,899				
1875.....	8,432	709,553				
1876.....	7,272	319,968				
	32,000	139,000				
1877.....	6,316	235,587				
1878.....	5,138	169,040				
1879.....	4,425	132,048				
1880.....	3,209	99,479				
1881.....	2,775	82,778				
1882.....	1,953	55,123				
1883.....	1,606	46,173				
1884.....	1,025	31,263				
1885.....	1,144	35,178				
1886.....	1,406	49,913				
1887.....	1,890	80,088				
1888.....	1,320	56,100				
1889.....	980	44,100				
1890.....	977	51,293				
1891.....	792	35,838				
1892.....	848	34,523				
1893.....	869	31,936				
1894.....	1,005	30,861	40,000	\$44,000	762	\$9,144
1895.....	1,100	36,000	41,000	41,000	750	8,250
1896.....	1,335	46,725	40,000	35,000	300	3,000
1897.....	3,605	135,185	25,000	18,500	300	2,000
1898.....	5,000	190,000			500	4,500
1899.....	4,780	245,000	16,600	18,675	100	700
1900.....	3,990	180,000	7,300	8,800		
1901.....	4,800	242,300				
1902.....	7,291	306,081				
1903.....	8,180	344,251				
1904.....	18,480	314,000				
1905.....	7,764	279,651	15,000	15,000		
1906.....	7,203	262,909				
1907.....	7,675	292,878	8,453	8,453		
1908.....	9,600	405,792			2,000	8,000
1909.....	8,900	440,241			6,000	34,576
1910.....	10,800	488,700			12,000	50,000
1911.....	9,775	449,748			10,000	30,625
1912.....	9,743	409,596			8,000	32,000
1913.....	9,719	390,995			11,000	35,000
1914.....	6,633	325,349			7,000	21,000
1915.....	6,291	475,370				
1916.....	11,110	1,032,156				
1917.....	11,150	1,057,770				
1918.....	10,715	1,234,027				
1919.....	7,409	668,989				
1920.....	3,887	296,942				
1921.....	6					
1922.....	6					
1923.....	6					
1924.....	4,670	\$320,758				
Totals.....	345,840	\$19,162,092	193,353	\$189,428	58,712	\$238,795

¹Includes crushed rock, rubble, rip-rap, sand, gravel.²Production of New Idria Mine from 1858-1866; yearly details not obtainable, though New Idria began operation in 1850.³Estimated output of Cerro Bonito, Monterey and Stayton mines. 1870-1877; yearly details concealed under heading of "various mines" in early reports.

ANTIMONY.

The world consumption of antimony is comparatively small, being less than 2% of the consumption of copper, zinc and lead. Normally the price of antimony is about the same as that of lead and most of the time below that of copper, but the antimony market is recognized as one of the most unstable of any of the metals. From an average price of 6 to $7\frac{1}{2}$ cents per lb. from 1908 to 1914 it advanced to 40 cents a lb. in 1916, due to the World War demand. Prices gradually declined from the high of 1916 to an average of 4.96 cents a lb. in 1921. Since 1921 the market has improved, becoming quite active in 1924, and during the last quarter of 1925 the metal was quoted at $24\frac{1}{2}$ cents a lb. Present quotations (March, 1926) are $18\frac{1}{2}$ – $20\frac{1}{2}$ cents. On account of the small amount of antimony used in alloying with other metals consumers are not greatly concerned about the price they pay, and a steady fair price would be much more advantageous to producers than the widely fluctuating prices of the last 20 years.

There was a small production of antimony from San Benito County during the period of high prices in 1916, 1917 and 1918. Since then there has been no activity until the present year. All of the deposits are situated in the Stayton district (originally mined for quicksilver) on Antimony Mountain, in the northeastern corner of the county but also extending over into Merced County.

There appear to be at least three distinct lines of croppings that carry the antimony. The ore is stibnite, which occurs in lenses in a brecciated siliceous gangue, classified by different writers as trachyte, asperite and rhyolite.

Some of these deposits were located as mining claims and others are on patented lands not held under the mining laws. They have been described in earlier reports under various mine names, including Appeal Mine, Florence Mine Group, French Antimony Mine, Gleason Mine, Rip Van Winkle Mine, Shriver Mine, and others. At the present time the deposits within San Benito County are all on lands (ranches) that have passed into private ownership and none of them are held as mining claims.

The owners of these ranches are: T. H. French, of Hollister, who holds part of Secs. 19, 20, 21, 28, 29, 31, and 32, and all of Sec. 30, T. 11 S., R. 7 E.; Wiley Garner, of Hollister, whose holdings include the $E\frac{1}{2}$ of Sec. 6 and part of Secs. 7 and 8, T. 12 S., R. 7 E.; R. B. Knox, of San Francisco, part of Sec. 8, and all of Sec. 5, T. 12 S., R. 7 E.

Davis Antimony Lease. At the beginning of 1925 Mr. J. O. Davis, 1770 Arch Street, Berkeley, secured a lease on the entire Knox holdings, which include the Stayton Antimony Mine (Stayton Quicksilver Mine) first located in 1870.

All ore which had been previously mined and was lying on the dumps was shipped out and Davis then began the systematic prospecting of the outcrops and ledges on the two mineralized zones trending across the property in a direction about N. 10° W. In doing this work several tons of high-grade stibnite have been segregated. Good ore was uncovered at 7 or 8 points on the ledges and a new lens was discovered near the south end of the property. The development has been sufficient to show that stibnite probably occurs in lenses of undetermined size, but more or less continuous, throughout the several thousand feet of

ledge matter. None of the prospect trenches and holes are over a few feet in depth, but a large part of the ore exposed could be readily hand-sorted to a shipping product and much additional low-grade ore exists. The property is favorably located, being only 15 miles from Hollister by good mountain road with down-hill haul to the railroad.

On the *Wiley Garner Property*, adjoining the Davis lease on the west, considerable work has been done on a lens which strikes north-west. About 10 tons of 50% stibnite was shipped from surface working years ago. In 1915 Day and Underwood, of Hollister, drove a tunnel 10 feet below the upper workings and uncovered about three feet of nearly solid stibnite crystallized in fine needles. A shaft was later sunk 14 feet and a short drift at this level shows considerable antimony, indicating that this lens is of fair size. A number of surface showings have also been noted at other points, but they are mostly low grade. At one locality on Sec. 7, however, evidently an old prospect hole, some high-grade coarsely-crystalline stibnite was recently found. No work is being done on the Garner holdings, but negotiations are under way which may lead to renewed operations here, either in conjunction with the adjoining Davis lease or independently.

No work is being done on the *French Ranch*, which also contains portions of the mineralized ledges crossing the Knox and Garner holdings.

On the *Rancho Santa Ana y Quien Sabe* four miles south of Antimony Peak croppings of high grade stibnite have been reported, but there has been no attempt to develop them. Owners, De Laveaga Estate, Hollister, Cal.

Bibl: State Mineralogist's Reports VIII, p. 485; X, p. 516; XI, p. 371; XV, pp. 622-624. Bull. 38, p. 260. Preliminary Report No. 5.

ASBESTOS.

On the southwest slope of Sampson Peak and extending down Clear Creek toward Hernandez in the eastern part of T. 18 S., R. 11 E., there is a broad belt of serpentine which contains in places considerable chrysotile asbestos.

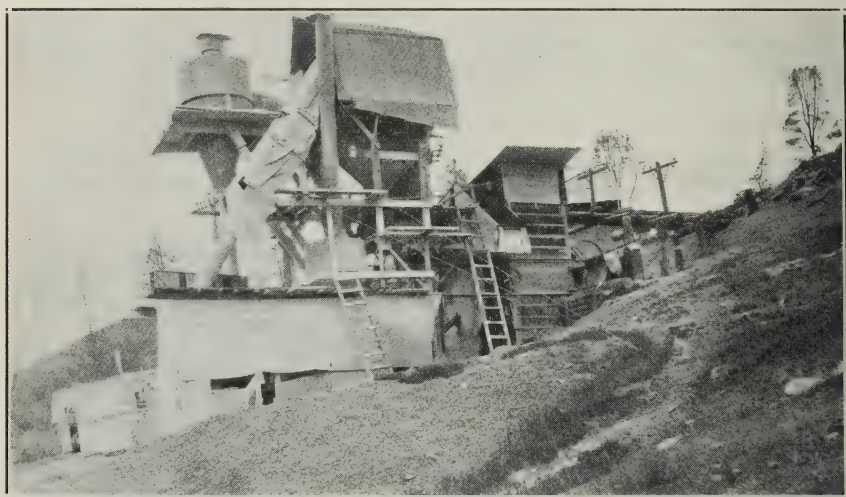
San Benito Asbestos Company. This company was organized in 1925, succeeding the California Asbestos Mining Company. Norris K. Davis, 400 7th Street, San Francisco, president. The property comprises six claims having a total area of 120 acres situated in Secs. 10 and 15, T. 18 S., R. 11 E., at an elevation of 3000 feet. The local address is Hernandez and there is a fair road following Clear Creek from there to the mine. The distance is approximately equal from the mine to King City on the west, or southeast to Coalinga, the nearest railroad points, it being about 35 miles either way.

The asbestos fiber varies from knife blade to $\frac{3}{4}$ -inch in length. It occurs as veins and seam filling in the serpentine which is here considerably broken and shattered and quite soft in places. Mining is by open cut with hand-drilling and blasting. The crude material is trammed to the fiberizing mill in cars, where it is crushed and the asbestos fiber fluffed and separated. More than two years were spent in perfecting the mill which is constructed according to original plans

of Mr. Davis and is patented. The final separation is by air. As the material has to be dry for proper milling, and artificial drying is not used, the mill can only be operated in the dry season. Electric power is used, furnished by the Coast Valleys Gas and Electric Company. At the time of visit no milling was being done, but one man was employed at the mine. The finished product is packed in 125-lb. sacks. The finely ground serpentine and dust which is carried by a conveyor to the dump has a consistency similar to low-grade ground soapstone and would probably have some value as a mineral filler if close to a market.

Other Deposits. At two or three other points along Clear Creek and south of it, desultory prospecting for asbestos has been carried on but nothing particularly encouraging has been opened up.

Bibl: State Mineralogist's Report XVIII, p. 214.



Asbestos fiberizing mill of San Benito Asbestos Company, San Benito County.

ASPHALT AND BITUMINOUS ROCK.

Asphalt has been commercially produced in a small way in the past from a portion of a deposit of bituminous rock situated in Secs. 32 and 33, T. 17 S., R. 8 E., 10 miles northeast of Metz.

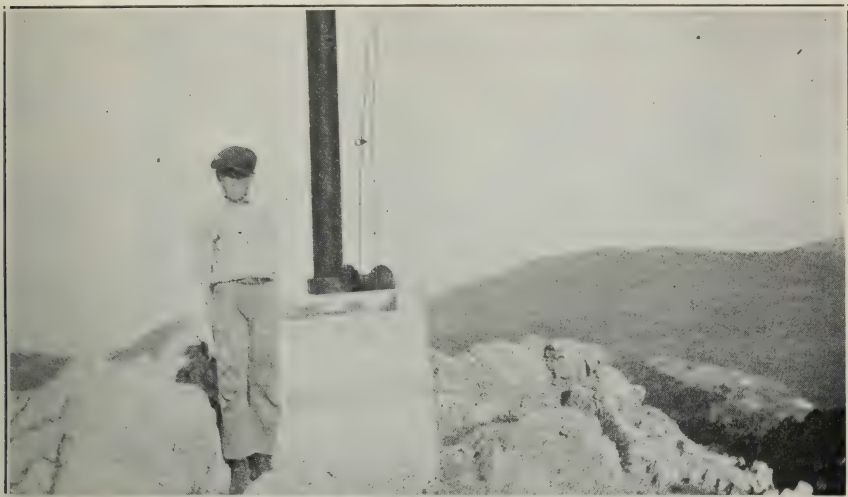
Mathews Quarry. A small quarry in bituminous sandstone at this locality is owned by John Mathews of King City but it has been idle for a decade or more and on account of the small size of the deposit and distance from the railroad it is of little economic importance.

Another outcropping of asphalt found on the Rancho El Gabilan, about two miles southwest of old Mission Portland Cement Company's quarries near San Juan Bautista, was discovered and prospected by H. V. Underwood of Hollister a few years ago, but the occurrence proved to be superficial.

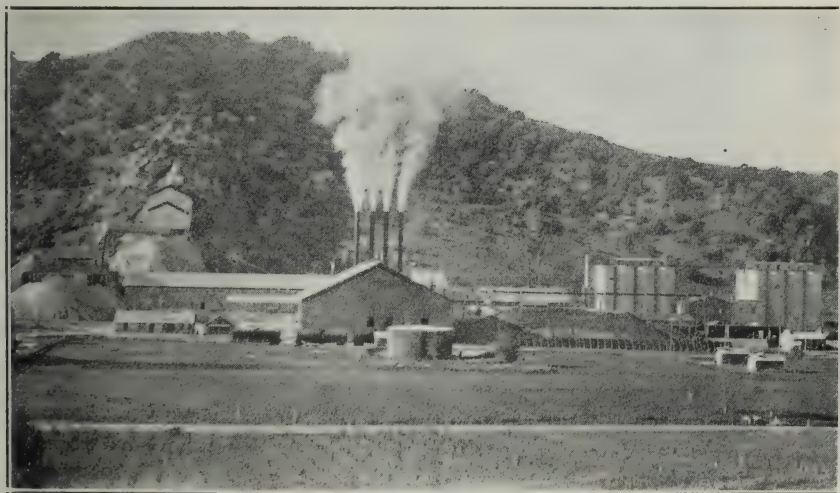
Bibl: State Mineralogist's Reports XV, p. 624; XVIII, p. 214.
U. S. Geological Survey Annual Report XXII, Part I, p. 409.

BARITE.

The only known occurrence of barite in the county is on Gabilan (Fremont) Peak. The main body which was mined out between 1915 and 1920 was on the Monterey County side of the line near the summit.



Native Sons' Memorial Marker and base of flag pole on summit of Gabilan (Fremont) Peak. Barite is found within a few hundred feet of this point on Monterey-San Benito County line. Elevation 3169 feet.



Plant of Old Mission Portland Cement Company, San Juan Bautista, San Benito County. Photo by courtesy of the company.

It had a width of six feet, length of about sixty feet and was enclosed in limestone walls. The barite mined here was high-grade, coarsely crystalline and white grinding. A small lens was also mined on the

northern side of the summit in San Benito County and it is possible that close search would uncover other bodies. It is twelve miles by fair road from San Juan Bautista to the summit of the peak which has an altitude of 3169 feet.

Bibl: State Mineralogist's Reports XV, p. 624; XVIII, p. 214.

CEMENT.

At the present time Portland cement is the most valuable individual mineral product of San Benito County. The output comes from a single plant which began operating in 1918.

Old Mission Portland Cement Company. Wm. F. Humphrey, president; J. A. McCarthy, vice president and general manager; C. B. Flick, Secretary; F. F. Parker, plant superintendent. Home office, 715 Standard Oil Building, San Francisco. The company's plant which is one of two in the state using the 'wet process' of manufacture of Portland cement is situated at San Juan Bautista. Operations began in 1918 and have been continuous ever since. The chief raw materials used, limestone and clay, are obtained on the company's property adjacent to the plant site, their holdings comprising approximately 2000 acres owned outright and mineral rights on 11,000 acres additional. Gypsum which represents 3% of the raw material consumed is obtained from Gerlach, Nevada.

The present limestone quarry is $3\frac{1}{2}$ miles from the plant and the clay deposit about the same distance up San Juan Canyon, but at a lower elevation. On account of the natural composition of the limestone only a comparatively small amount of clay is mined.

At the limestone quarry Jackhammer air drills are used and after blasting the rock is loaded by steam shovel into $4\frac{1}{2}$ -yard cars and hauled by a gasoline locomotive three-quarters of a mile to loading bunkers. From these bunkers the limestone is conveyed by a surface tram 1300 feet long with a vertical drop of 700 feet to the lower bunkers from which it is taken by train to the plant.

Both the limestone and clay are delivered to the plant in trains of $4\frac{1}{2}$ -yard cars of 36" gauge by a 20-ton oil-burning steam locomotive. The cars dump into a hopper feeding a No. 8 K Gates gyratory crusher. The material then goes to a No. 5 Jumbo Williams mill which discharges to a 24" belt conveyor delivering to two storage piles. From storage the material is delivered by belt conveyor to three raw wet-grinding 7' x 9' ball-mills. Discharge from raw ball-mills is taken by screw conveyor and elevator to a raw tube-mill feed tank which feeds five 6' x 22' raw tube-mills. Tube-mill discharge passes by screw conveyor to mixing chambers, thence by a 3" centrifugal pump to concrete slurry storage silos. A 6" centrifugal transfer pump delivers the slurry to two 20' deep by 28' diameter concrete Dorr mixing tanks equipped with Dorr agitators. From the Dorr mixing tanks 2" centrifugal pumps deliver the slurry to four kiln feed-boxes from which it is delivered by slurry feed-wheels to the feed pipes of the kilns. There are four 7' x 150' oil-fired rotary kilns which discharge to four 6' x 50' revolving coolers. The burned and partly cooled clinker is taken from the coolers by pan conveyor and delivered to a concrete clinker pit 20' x 20' x 15' deep. A monorail conveyor with $1\frac{1}{2}$ -yard bucket transfers the clinker from the pit to ground storage. The same monorail

bucket transfers the clinker from storage to the clinker ball-mill feed bin. If required, on account of getting wet in storage, the clinker is by-passed to a dryer bin, passed through a dryer and then delivered by elevator to the clinker ball-mill feed bin. The clinker ball-mill bin



Steinbeck Quarry, looking east. Locomotive and cars from Marble Falls Quarry. Old Mission Portland Cement Company, San Juan Bautista. Photo by courtesy of the company.

discharges to a pan conveyor, where gypsum from the gypsum bin is added, thence it is taken by elevator and drag conveyor to the finish ball-mill feed bin. The discharge from the finish ball-mill passes to an elevator discharging to an electric Hum-mer screen. The screen over-size is returned to the ball mill, the undersize passing by screw con-

veyor to the finish tube-mill feed bins. There are five 6' x 22' finish tube-mills, the finished product from these mills passes by screw conveyor and then by an elevator and conveyor, or a cement pump (air), to concrete cement-storage silos. There are eight circular silos 20' in diameter by 69' high; eight, 21' in diameter by 69' high and three star bins. From the storage silos the cement is drawn by screw conveyors, then elevated and delivered to four bins feeding four Bates packers from which the sacked cement is transferred by conveyor, automatically counted, and delivered to railroad cars for shipment.

The entire plant is of concrete and steel construction and electrically operated, power being furnished by the Pacific Gas and Electric Company. Equipment includes all modern devices for the control of operations and production of the highest quality product. The California Central Railroad, a standard-gauge line 8 miles in length controlled by the company, connects the plant with the Southern Pacific main coast line at Chittenden. The plant has a daily capacity of 2300 barrels of cement and 175 men are employed.

Bibl: State Mineralogist's Reports XV, pp. 626-630; XVIII, pp. 215, 218.

CHROMITE.

No large deposits of chrome ore have been found in San Benito County, although the mineral occurs abundantly in the extensive serpentine area lying south of Idria, as small float and boulders. Natural erosion of the serpentine has concentrated this mineral in the ravines and stream gravels. Several carloads of the larger masses of chromite thus concentrated, were gathered and shipped out as early as 1875.

In 1917 various individuals living in that section collected small lots of chrome ore, some of which were sold to ore buyers and some still remains piled at various points. Most of it went out via Mendota, but a little was shipped through Coalinga, King City and Hollister. One lot seen at the Aurora Quicksilver Mine appeared to be of very good quality.

José Tirado, Hernandez, California, has a claim in this area on which there is said to be a good-size lens of chromite. It is adjacent to a road, but is idle as are all other chrome mining activities in the county at the present time.

Bibl: State Mineralogist's Reports IV, p. 136; VI, pt. I, p. 100; VIII, pp. 483, 490; XV, p. 630. Bull. 27, p. 126; Bull. 38, pp. 269, 362; Bull. 76, p. 166. U. S. Geol. Survey Bull. 603, p. 208.

CLAY.

The larger valleys of San Benito River and its tributaries and the surrounding foothills undoubtedly contain extensive deposits of clay, some of which may prove to be valuable for industrial purposes.

Dr. J. M. O'Donnell of Hollister owns a deposit along Bird Creek, three miles south of Hollister. The bed is exposed for a considerable depth in several of the gulches and a well was sunk 80 feet without reaching the underlying rock. The clay is light grey in color, very

plastic and without grit. It burns to a cherry red and is said to be suitable for pottery use.

The *Alpine Quicksilver Mining Company* in 1915 burned about 260,000 brick in field kilns on lower Clear Creek near Hernandez for use in building their reduction furnace. The clay was dug locally. Some of these brick still remain along the road and appear to be of good quality.

M. A. Martin formerly of Hollister located some clay which burns white or nearly white near the head of Willow Creek in T. 15 S., R. 6 E.

H. V. Underwood of Hollister has submitted samples of plastic clay of fairly high alumina content found at several points in the county.

There is a deposit of clay containing considerable sandy material on the *C. H. Abbe Ranch* 12 miles south of Paicines on the Idria road. This clay fuses at a rather low temperature but does not crack or swell. It appears to be on the order of an impure montmorillonite. The bed stands practically vertical and cuts across a ridge from top to bottom. The spring mentioned under 'Mineral Water,' on the Abbe property issues near the base of this clay bed.

A white knolinized rock that slowly breaks down in water forming a slightly plastic clay with a comparatively low fusing point is exposed in a cut along the San Benito road about 18 miles south of Tres Pinos. This variety of clay could probably be utilized in the ceramic industries. It is undeveloped.

W. T. Maeder, 554 66th street, Oakland, California, has submitted a sample of siliceous clay, possibly a fire clay, from the Bitterwater section. Undeveloped.

There has been no commercial output of clays, as such, in the county, and the only clay material being utilized at the present time is that mined by Old Mission Portland Cement Company for the manufacture of cement at their plant at San Juan Bautista.

The clay resources of the county have not as yet been fully ascertained or closely investigated. Additional data will be contained in a new bulletin to be issued by the Bureau on the Clay Resources of the State, which is now in course of preparation by the author, Mr. W. F. Dietrich, Ceramic Engineer.

Bibl: State Mineralogist's Report XV, p. 630. Bull. 38, p. 226. Preliminary Report No. 7, p. 91.

COAL.

Coal prospects have been noted at many points in the sedimentary rocks of the county, but at only a few places have important deposits been opened up. Lignite, some of which is of the jet variety, and sub-bituminous and bituminous coal occurs, and the deposits are of such size in a few cases as to rank among the best in the state. Although distance from transportation has handicapped their profitable exploitation, there can be no doubt as to the potential value of the coal in this county.

The only deposits that have been developed to any extent are the Mascovich mine and that of the San Benito Coal Mining Co., both in the southern end of the county.

Mascovich Coal Mine (formerly *Trafton Mine*). Owner, N. P. Mascovich, Rt. A, Box 19, Gilroy, California. The mine is situated near the head of James Creek at an elevation of 2300 feet, in Sec. 21, T. 17 S., R. 10 E. It was first opened by Trafton in 1870. He drove one shaft on the vein, but only made a small production, after which the mine laid idle for many years. About 1907 it was taken under lease by the Monterey Coal Co. This company did some work in the old shaft and also put down another to a depth of 70 feet. The mine was equipped with a steam-boiler, engine and hoist, using coal from the mine for fuel. Their operations were not a financial success, however, and the mine reverted to the owner. Mascovich continued the shaft started by the Monterey Coal Co. to an incline depth of 158 feet. He also drove a tunnel 80 feet, connecting with the bottom of the shaft for drainage purposes, but this tunnel is bulkheaded and the water allowed to stand in the shaft. At the time of visit it was within 20 feet of the collar. Another cross-cut tunnel was started 250 feet lower down the hillside, which will give about 500 feet of backs if continued until it taps the vein.

The coal vein outcrops plainly along the hillside where it can be readily traced for 1200 feet. The strike is nearly north and the dip 37° to 40° W. Underlying the coal is a thin stratum of bituminous sandstone, below which is a heavy bed of dark grey sandstone. The roof is shale, overlain by 10 feet of sandstone. Above this there is another 6" to 8" vein of coal, overlain by alternate strata of shale and sandstone with some conglomerate.

The shaft, which is 5' by 8' in cross-section, with an inclination of $37\frac{1}{2}^{\circ}$, is sunk directly on the vein. Where the coal is exposed above the water level it is standing perfectly, and there are no signs of disintegration or softening deeper than one-half inch from the surface, although it has been standing exposed to the air for years. Analyses show the coal to contain 54% fixed carbon and to have a heat value of 13,220 B. t. u. or 7345 calories. It no doubt compares favorably with any other coal in the state, and the thickness of the vein and its position with reference to the proposed lower tunnel would permit cheap mining. All equipment except the boiler has been removed since the last work in 1913, and the upper end of the road has not been kept in repair, but a car may still be driven to within one-quarter mile of the workings. As a solution of the transportation problem, it has been suggested that powdered coal for industrial plants might be produced at the mine and transported by pipe-line to the nearest railroad point 22 miles distant, using air as the carrying medium.

San Benito Coal Mining Co. John J. Shoo, president, 542 Lakeshore Boulevard, Oakland; Earle D. White, secretary and treasurer, Bank of Italy Building, Oakland. The deposit owned by this company was discovered about 20 years ago and some coal was mined and sold to the New Idria Quicksilver Mining Co. Since that time the mine remained idle and the workings flooded until taken over by the present company in August, 1921.

The property comprises 280 acres of patented land and other holdings on Larious Creek near the Ashhurst Ranch in T. 17 S., R. 11 E., in the New Idria district. Mendota, the nearest railroad point, is 33 miles distant. Llanada is the local post office.

The mine was equipped with a gas engine and blower, track, cars, and hand tools, and development began in 1922. Work has been carried on intermittently during the past several years, but there has been no commercial production to date, and the mine is at present shut down.

The coal so far exposed is sub-bituminous in character and occurs in veins from $2\frac{1}{2}$ to $7\frac{1}{2}$ feet in thickness between sandstone walls. Three veins are known and have been traced for several miles on the surface. A tunnel 200 feet in length cuts a vein 6 feet wide at a depth of 70 feet from the surface, and another tunnel about 700 feet in length, one mile distant, has cut the first vein. The coal dips at an angle of 60° to 70° . An analysis shows the following content:

	Per cent
Moisture -----	8.6
Volatiles (including sulphur 2.58%) -----	49.5
Fixed carbon -----	36.6
Ash -----	5.3
B. t. u. 10750	

Another sample from near the surface analyzed by Smith, Emery & Co., August 16, 1921, gave:

	Per cent As received	Per cent Dry
Moisture -----	9.45	---
Volatile and combustible matter -----	43.96	48.55
Fixed carbon -----	36.39	40.51
Ash -----	9.90	10.94
Sulphur 2.90%		
Calories -----	5514	6089
B. t. u. -----	9925	10961

Bibl: State Mineralogist's Reports IV, p. 14; V, p. 104; VI, p. 117; VIII, p. 483; XI, p. 372; XII, p. 61; XIII, p. 54; XV, p. 631; XVIII, pp. 145, 146. U. S. Geol. Survey Bull. 431, p. 243; Bull. 585, p. 29; Bull. 603, p. 209. U. S. Bureau of Mines Bull. 22, pp. 53, 396.

COPPER.

There is no recorded output of copper from San Benito County, but prospects have been located at several points and considerable development work has been done at various times beginning in the eighties.

Antelope Copper Mine. This discovery was made in 1887. The mineralized formation appears to be a compact fine-grained sandstone or sandy slate impregnated with copper and iron. The dip is to the southeast but the strata are much broken and disturbed. The principal mineralization is in streaks along joint planes which occasionally develop into nodules and pockets of good ore carrying oxide and carbonate of copper and iron-oxide. Some of this ore from which the sacks have rotted away is still lying on the dump.

The early workings which are badly caved consisted of two inclines, one about 400 feet in length running a little west of south and apparently passing through and then continuing below the mineralized

zone; the other, about 40 feet farther down the hill, was 100 feet in length but did not reach the ledge.

The property was abandoned for years but was relocated recently by H. V. Underwood, E. A. and R. W. Mathews, address H. V. Underwood, R. F. D., Hollister, California. They have located three claims, a total of 60 acres, being situated in Sec. 4, T. 15 S., R. 9 E., 25 miles



Antelope Copper Mine, San Benito County.

south of Tres Pinos and not far from the Idria road, at an elevation of 2500 feet. Juniper and oak cover the hills. There are springs nearby and a little water seepage from one of the mine tunnels. The new owners have driven an incline at an angle of about 10° from the horizontal running a little south of east for 200 feet and this incline passes through the copper-bearing formation at a slight angle for a distance

of approximately 60 feet. A winze 10 feet deep 100 feet in, is still in the ledge matter indicating a zone of mineralization at least 20 feet thick. The walls of this working are covered with a thin scale of green chalcanthite, a hydrous sulphate of copper which is a common evaporation product resulting from the alteration of copper sulphides. Nodules and bunches of oxidized copper minerals also occur in seams in the rock. The green chalcanthite may be scraped from the walls, and carries a high percentage of copper which can be leached out by water. Chalcanthite is usually an unimportant ore of copper but it is probable that some copper could be produced here by a simple acid or water leaching process. Idle except for assessment work.

Copper Mountain Mining Company, F. H. Melville, president, controlled for many years a large property at the Palisades and Pinnacles, San Benito County. Their holdings included 26 lode claims; also the $SE\frac{1}{4}$, Sec. 33, T. 16 S., R. 7 E.; the $NW\frac{1}{4}$ of $SW\frac{1}{4}$; $SW\frac{1}{4}$ of $NW\frac{1}{4}$ and $N\frac{1}{2}$ of $NW\frac{1}{4}$, Sec. 34, T. 16 S., R. 7 E., covering townsite, millsites and water right.

The claims cover a mineralized zone mainly in coarse-grained granite with feldspar predominating in many places. The zone is marked in places by iron gossan and the granite is more or less stained with copper carbonate. Chalcopyrite is rarely visible and some gray copper mineral has been noted. Assays were said to show 3% copper with small gold and silver values. Molybdenite is sparsely disseminated in the granite in places. In one tunnel a lens of feldspar 30 feet in thickness was cut.

The company has been in almost continuous litigation with various individuals and the Department of the Interior over the question of the mineral or non-mineral character of the land, on account of the location of their holdings controlling the western entrance to Pinnacles National Monument and the desire of the government to develop the land for public use.

With the reported recent ousting of the mining company from all right and title to the ground by decision of Land Office officials and approval by the highest authority, the final chapter in this litigation appears to have been written and obviously no further attempt can be made to develop a mine here.

Lewis Creek Claim. Some development work including a tunnel 100 feet in length was done on a claim near Lewis Creek in Secs. 2, 3 and 4, T. 19 S., R. 10 E., about 20 years ago, but no ore was developed. Idle for years.

DIATOMACEOUS EARTH.

No deposits of this material have been developed within the county although several occurrences have been reported. It is found on the *Leonard Estate* in Sec. 28, T. 17 S., R. 8 E., and on adjacent sections outcropping in rounded knolls for a distance of over a mile. A deposit has also been noted near San Benito on the *N. D. Page Property*, and it occurs on the holdings of *Thos. Melendy* interstratified with narrow veins of gypsum in Sec. 28, T. 17 S., R. 8 E. Metz, the nearest railroad station, is ten miles distant. As there are large deposits of diatomaceous earth in other counties that lie adjacent

to rail or water transportation, there is little likelihood of any immediate development in this county.

Bibl: State Mineralogist's Reports XV, p. 636; XVIII, p. 217.

DOLOMITE.

Dolomite of good quality is associated with the limestone deposits in the foothills of the Gabilan Range, in the Cienega district southwest of Hollister. There has been a fairly consistent annual production for the past ten years, the material being used mainly for the making of refractory basic linings in open-hearth steel furnaces.

Quarries have been opened up and production has come from the *O'Hara Ranch Deposit*, 11 miles southeast of Hollister; from the property of the *San Benito Vineyards Co.*, 10 miles southeast of



Dolomite Quarry in Cienega Del Gabilan District, San Benito County, operated by A. E. Hamilton, Hollister, Cal.

Hollister; from the adjacent *Leopold Palmtag Property* and from the *E. L. Martin Ranch Deposit*, 8 miles southwest of Hollister.

Recently one of the larger San Francisco consumers has acquired a deposit in Monterey County from which it is drawing its supply, and this action has curtailed production from the San Benito quarries. At the present time only one deposit is being worked.

Hamilton Quarry. This is on property now owned by Mortimer Fleischhacker of San Francisco, but formerly a portion of the San Benito Vineyards Co.'s holdings. A. E. Hamilton, Hollister, California, is operating it under a lease with a small crew of men. The dolomite is blasted loose after hand-drilling, or broken down with bars and picks, and shoveled into 5-ton trucks. There is a good road to Hollister and a loading platform there from which the trucks dump direct to railroad cars. About one car every three days is now going out. Besides operating this lease, Mr. Hamilton owns the

former *McBurney Property* in T. 14 S., R. 5 E., in the same vicinity upon which both limestone and dolomite occur.

Bibl: State Mineralogist's Report XV, pp. 633-636.

GEMS.

The discovery of a new gem mineral in San Benito County in 1907 created considerable scientific interest at the time but little has been accomplished in commercializing the product. The mineral, which was named Benitoite, is a titano-silicate of barium ($\text{BaTiSi}_3\text{O}_6$). It is transparent, the color varying from colorless to deep blue; hardness 6.5 and sp. gr. 3.64—3.65. The benitoite occurs with natrolite and neptunite in a zone of narrow veins in serpentine.

Dallas Mining Company. The deposit is covered by two patented mining claims owned by the Dallas Mining Company, R. W. Dallas, president, Coalinga, California. They are in Sec. 25, T. 18 S., R. 12 E., 12 miles southeast of Idria, at an elevation of 4600 feet.

In 1920 the mine was leased to the San Benito Gem Company, B. C. Suit, president, Hollister, California, but the property has remained idle.

Bibl: State Mineralogist's Report XV, p. 636. Bull. 67, p. 157. Bull. Dept. Geol. Univ. of Cal., Vol. 5, pp. 149, 331. U. S. Geol. Survey Bull. 603, p. 208. Mineral Resources 1909, Pt. II, p. 742. Am. Jour. Sci., Vol. 27, p. 398. Science, 1908, p. 616.

GOLD.

The extent of the county's mineralization is emphasized by recording the fact that gold has been found in place at several localities in sufficient quantity to encourage the expenditure of considerable money in carrying on prospecting operations. However, all such attempts have been long since abandoned, and hope of commercially producing gold has ended. In the eighties an attempt was made to do some placer mining in the Panoche Valley, but nothing was accomplished.

The *Chalone Mine* and *Defiance Mine* were opened by Thos. Flint of Hollister in 1890. The properties were situated on a volcanic ridge northeast of North Chalone Peak in Sec. 14, T. 17 S., R. 7 E. Some assays as high as \$94 per ton were obtained here and numerous samples showed from \$1 to \$5 per ton. A tunnel was driven in 540 feet on the Chalone and another 400 feet on the Defiance but no distinct orebodies were found, the gold apparently being a primary constituent of the unaltered country rock. On account of the discouraging results of the work the properties were soon after abandoned.

A sample of andesitic rock taken from the surface at a point 3 miles south of the above workings by L. H. Day of Hollister was also reported to show some gold content.

Small ledges in a hill on the *Flint Estate* in San Juan Canyon, west of Hollister, gave samples assaying as high as \$25 to \$30 per ton and a tunnel 300' in length was driven here but only narrow stringers carrying little or no gold values were found at depth and work was abandoned in 1896.

Bibl: State Mineralogist's Reports VIII, p. 490; XII, p. 227; XIII, p. 318; XV, p. 637.

GYPSUM.

There has been a large tonnage of gypsum produced in San Benito County, some of which undoubtedly has not become of record. Part of the output was also credited to Monterey County, as it was shipped from King City. The deposits are far from exhausted, but there has been no activity in this branch of mining for the past 10 years.

The most important deposits are found in the Topo and Bitterwater section where gypsum beds form a conspicuous part of the sediments that mantle large areas. Workable deposits are mainly of the massive grey variety in the form of gently inclined beds. These are in places several hundred acres in extent, but are often cut into smaller residual hills by erosion. Some development work has been done on deposits in Sec. 5, T. 19 S., R. 10 E.; in Sec. 32, T. 18 S., R. 10 E.; Sec. 15, T. 18 S., R. 9 E.; Secs. 8 and 17, T. 18 S., R. 9 E.; Sec. 11, T. 18 S., R. 10 E., and at other localities in this region, which are described in earlier reports mentioned in the bibliography.

Lyons Gypsum Co. The largest output has come from quarries located in Secs. 8 and 17, T. 18 S., R. 9 E., 13 miles east of King City. They were formerly known as the Dunne Gypsum Quarries, but are now controlled by the *Lyons Gypsum Co.*, T. W. G. Lyons, president, King City. Considerable production has also come from quarries on the Tannehill Ranch, 12 miles east of King City on Bitterwater road, which were leased by T. W. G. Lyons.

The gypsum bed on the Lyons Gypsum Company's property is covered by an overburden 6 to 12 feet in depth, which was removed with 2-horse scrapers. The underlying gypsum bed averaged six feet in thickness. It was blasted out and broken in blocks convenient for handling and hauled to King City for shipment.

Bibl: State Mineralogist's Reports VIII, p. 490; XIII, p. 504; XV, pp. 638-639. Bull. 38, p. 287.

IRON.

Surface indications of iron deposits, both hematite and magnetite, have been noted at several places in the county, but none of them have been developed.

Hematite croppings have been reported in Sec. 6, T. 15 S., R. 6 E., two miles south of the old lime kilns of the Cienega Lime Co. and 15 miles from Tres Pinos. Indications have also been mentioned as occurring in T. 17 S., R. 12 E., and in the country between Stayton and Panoche Pass.

There is a small iron gossan on the Antelope Copper Mine claims in Sec. 4, T. 15 S., R. 9 E.

Bibl: State Mineralogist's Reports VIII, p. 490; XV, p. 639. Bull. 38, p. 299.

LIME AND LIMESTONE.

Massive crystalline limestone of good quality, suitable for the manufacture of lime and cement and for other industrial purposes, outcrops prominently along the Gabilan Range from San Juan Bautista to the region around Pine Rock in T. 16 S., R. 8 E.

This limestone is in part dolomitic and in places deposits of pure dolomite occur. The deposits have been long known but only a few of them have been developed to any extent. Lime has been made at several places in the past and some of the old kilns are still standing, but no lime has been burned here for the past twenty years. The only producing quarries at the present time along this belt are those of the Old Mission Portland Cement Company producing limestone for their plant at San Juan Bautista, and a dolomite quarry operated by A. E. Hamilton (see under dolomite).

All other deposits are lying idle in a more or less undeveloped state although there has been some changes in ownerships since former reports were issued.

Henry Cowell Lime and Cement Company, No. 2 Market St., San Francisco, owns 1044 acres of land containing extensive deposits of limestone in Secs. 28, 29, 30 and 32, T. 14 S., R. 6 E., and Secs. 14 and 24, T. 14 S., R. 5 E., about thirteen miles from Tres Pinos in the vicinity of Thompson Creek. About 26 years ago the Cienega Lime Company operated four kilns of 50-barrel capacity each on this property, but there has been no production since the property was acquired by the present owners.

D. F. H. McPhail, Hollister, California, owns 245 acres of land in Secs. 23 and 13, T. 14 S., R. 5 E., 14 miles southeast of Tres Pinos. A tract of 81 acres in Sec. 23 contains a particularly bold outcropping, the limestone standing up possibly 150 feet above the base in places. Various analyses have shown the material to contain 96% CaCO_3 and from $2\frac{1}{2}\%$ to 4% MgCO_3 . The property is for sale.

D. F. H. McPhail, *U. G. Harlan*, et al., of Hollister, also own considerable acreage in Secs. 23 and 24, T. 14 S., R. 5 E., containing limestone and on which lime was burned at one time.

Old Mission Portland Cement Company. This company owns 2000 acres and the mineral rights on 11,000 additional acres covering their plant site and limestone deposits in the Cienega del Gabilan district near San Juan Bautista (see under Cement).

San Benito Lime Deposit, also known as the Connelly and Kruse limestone deposit, is situated in Sec. 23, T. 14 S., R. 5 E., adjacent to the McPhail holdings. The property has recently been purchased by Hamilton, Fontaine and Temple, address A. E. Hamilton, Hollister, California, or Temple and Hamilton, 1st and Santa Clara Streets, San Jose, California.

The new owners contemplate installation of kilns and production of lime in the near future.

Bibl: State Mineralogist's Reports VI, pp. 28, 29; VIII, p. 488; XII, p. 393; XIII, p. 629; XV, pp. 626, 633, 640; XVIII, pp. 217, 218. Bull. 38, p. 76.

MAGNESITE.

Production of magnesite began in 1917 in San Benito County. The deposits so far developed are all in Secs. 34, 35 and 36, T. 17 S., R. 11 E., on a high spur running westerly from Sampson Peak and lying between two forks of Larious Creek at an elevation of 3900 feet.

Sampson Magnesite Mine (Maltby No. 3 Mine) comprises 21 claims. It is equipped with a rotary kiln and aerial tram 5000 feet in length for delivering the ore from the mine on top of the ridge to the furnace. It is being operated under lease by C. S. Maltby, Humboldt Bank Building, San Francisco, and ranks as one of the state's important producing properties.

Superior Magnesite Co., organized by H. A. Palmer, et al., of Hollywood, has acquired the Standard Group of 11 claims adjoining the Sampson Peak Mine, and are installing machinery for operating. As the magnesite mining industry of the state is described in detail in a special bulletin¹ published during the latter part of 1925, which includes operations in San Benito County, the properties were not visited during the present survey.

Bibl: State Mineralogist's Reports XV, pp. 643-645; XVIII, pp. 218-219; XIX, p. 26; XX, p. 28; Bull. 79. U. S. Geol. Survey Bull. 355, p. 38; Bull. 540, pp. 503-509; Bull. 603, p. 208; Min. Res. of U. S., 1911, Pt. II, p. 1120.

MANGANESE.

San Benito County was not an important producer of the 'war minerals' manganese or chrome, even during the period of high prices and urgent demand preceding the signing of the armistice. Since then there has been no activity whatever at the several manganese deposits which were more or less developed and from which a small amount of manganese ore was produced. The deposits are all in the Diablo Range in the eastern portion of the county, and have been described in detail in Bulletin 76, 'Manganese and Chromium in California,' 1918.

Fries Ranch Manganese Deposit is associated with red jasper outcropping in Secs. 5 and 8, T. 13 S., R. 8 E., 18 miles by road east of Tres Pinos.

Hannagan Ranch Manganese Deposit occurs in the SW $\frac{1}{4}$ of Sec. 22, T. 15 S., R. 9 E., and is about 31 miles by road southeast of Tres Pinos near the west end of Big Panoche Valley. Three feet of good ore was exposed here.

Hawkins Ranch Manganese Deposit is in Sec. 35, T. 11 S., R. 6 E., 13 miles northeast of Hollister. Some ore averaging over 40% metallic manganese has been shipped from this property.

Hendricks Mine. This property comprises 80 acres of patented land in Sec. 24, T. 13 S., R. 8 E.; D. F. H. McPhail, agent, Hollister, California. It is 23 miles east of Tres Pinos by good road and lies close to the Merced County line. A good-sized orebody is exposed here, which is said to have been first opened up over 35 years ago.

Lewis Ranch Manganese Deposit. This is a small deposit in Sec. 7, T. 13 S., R. 8 E., adjoining that on the Fries Ranch.

Bibl: State Mineralogist's Reports XII, p. 330; XV, p. 644. Bull. 38, p. 336; Bull. 76, pp. 59-61.

¹ Bradley, W. W., Magnesite in California, Bulletin No. 79, 1925.

MINERAL WATER.

Abbe Spring. There is a small spring on the property of C. H. Abbe, 12 miles south of Paicines on the Idria road, the water of which is mineralized, as indicated by its taste, and which is considered 'not fit to drink' by the owner though used for watering cattle. All vegetation is killed where the water flows upon the ground. An analysis of the water has never been made.

San Benito Mineral Spring. Owner, E. J. Anderson, Rt. 1, Box 150, Hollister, California. This property comprises 160 acres, situated on the Southern Pacific railroad, four miles southeast of Hollister, the springs being a flag stop. The paved highway to Tres Pinos also passes the property. The water is obtained from a well 286 feet deep, drilled about 1890. It rises to within 100 feet of the surface from which depth it has to be pumped. As indicated by the following analysis, by M. E. Jaffa, the water contains a large amount of the sulphate radical which it is claimed gives it definite medicinal effects.

Properties of reaction:

Primary salinity	85
Secondary salinity	0
Tertiary salinity	0
Primary alkalinity	7
Secondary alkalinity	8
Tertiary alkalinity	?

Constituents in parts per million:

	By weight	Reacting values
Sodium (Na) }	780	33.94
Potassium (K) }		
Calcium (Ca)	29	1.46
Magnesium (Mg)	18	1.50
Iron (Fe)	8.9	.32
Sulphate (SO ₄)	736	15.32
Chloride (Cl)	566	15.97
Carbonate (CO ₃)	178	5.93
Silica (SiO ₂), organic matter and combined water	188	
	2,503.9	

There is a small bath house at the spring. The water is used locally to some extent but is not bottled or sold on a commercial scale, and practically no effort has been made by the present owner to develop the property into a health resort. Parties are at present negotiating for a lease, which if granted will probably result in further improvement.

Bibl: State Mineralogist's Reports XIII, p. 516; XV, p. 645.
U. S. Geol. Survey W. S. Paper 338, p. 306.

PETROLEUM.

Prospecting for, production and refining of mineral oil differs so radically from other forms of mining that it is usually treated as a distinct and independent industry. It requires specialized study for proper presentation, and therefore, the petroleum resources and possibilities of the county are not included in this report.

Seepages of oil and gas have been long known to exist in a number of localities and considerable drilling has been carried on, but to date without commercial production resulting. The geology and oil possi-

bilities in this area are discussed in detail in the publications listed in the bibliography, to which the reader is referred. Current oil field operations are reported in 'Summary of Operations, California Oil Fields,' published monthly by the Department of Petroleum and Gas of the State Mining Bureau.

The following data regarding prospect wells drilling within the county from 1914 to 1924, inclusive, are from records compiled by the State Oil and Gas Supervisor:¹

Company	Well No.	Sec.	Twp.	Range	Date started	Depth
Hamiltonian Oil Company-----	1	19	16 S	11 E	1922	225
S. F. Panoche-----		13	16 S	10 E	1922	
Merced Paraffine Oil Company-----	1	8	17 S	11 E	Prior 1916	1500
Union Oil Company of California-----	'Griffin' 1	36	18 S	9 E	1921	3480
Standard Oil Company-----	La France	33	17 S	9 E	1914	2408
Standard Oil Company-----	'Stone' 1	27	17 S	8 E	Prior 1915	
Standard Oil Company-----	Leonard 1	28	17 S	8 E	Prior 1915	
Petroleum Midway Limited-----	1	10	12 S	4 E	1924	5200
Watson, Douglas S. (Breacita Oil Company)-----	1	5	12 S	4 E	1922	3297

Bibl: State Mineralogist's Reports VIII, p. 488; XI, p. 372; XII, p. 356; XV, p. 646. Bull. 19, p. 148; Bull. 69; Bull. 89, pp. 69-82. U. S. Geol. Survey Bull. 431; Bull. 581d; Bull. 603; Monograph XIII.

QUICKSILVER.

San Benito County, due mainly to operations at the New Idria Mine, has been the leading quicksilver producing center, not only in California but in the United States, for the last 20 years.

The quicksilver mining industry of the county has been comprehensively described in Bulletin No. 78, 'Quicksilver Resources of California,' by Walter W. Bradley, 1918. This bulletin discusses the geology and ore occurrences in the several districts in the county, lists the mines, and contains data covering their history, development, equipment, possibilities and metallurgical practice. It also contains maps of the districts and a complete bibliography referring to the separate properties and to the general subject in all its phases.

As Bulletin No. 78 is still available and there has been little change in the status of most of the mines, detailed descriptions will be omitted in this report and only such changes in ownership and new developments as were found are given herein.

Alpine Mine. This property which formerly consisted of 32 full claims in Secs. 13 and 14, T. 18 S., R. 11 E., owned by the Alpine Quicksilver Mining Company, one time called the Esmeralda Quicksilver Mining Co., is now owned by H. B. Leonard, San Benito, California. All claims except three have been abandoned. A new plant completed in 1916 included an improved Scott furnace of 20-ton capacity and seven brick condensers. It was only operated a few months and has been closed down since the summer of 1917. The mine is idle except for assessment work.

Bibl: State Mineralogist's Report XV, pp. 649-651; Bull. 78, pp. 96-98.

¹ Bush, R. D., Results of Wildcat Drilling in California, 1914-1924, 'Summary of Operations, California Oil Fields,' Vol. 11, No. 1, July 1925.

Andy Johnson and Fourth of July Mines (Flint Group). This patented property consisting of 552 acres in Secs. 2, 11, 12 and 13, T. 18 S., R. 11 E., and Sec. 18, T. 18 S., R. 12 E., owned by Thomas Flint of Hollister, has remained idle since lessees ceased work in November, 1917.

Bibl: State Mineralogist's Report XV, p. 654; Bull. 27, pp. 131, 137, 138; Bull. 78, pp. 98-99. U. S. Geol. Survey Mon. XIII, p. 309. Geol. Survey of Cal., Geol. Vol. II, p. 123.

Aurora Group. No new developments have taken place at this property in Sec. 5, T. 18 S., R. 12 E., and Secs. 11, 12, 13 and 14, T. 18 S., R. 11 E. It has remained idle since July, 1917.

Bibl: State Mineralogist's Report XV, p. 652; Bull. 27, p. 131; Bull. 78, pp. 99-100. Min. Res. W. of Rocky Mts., 1874, p. 381. U. S. Geol. Survey Mon. XIII, pp. 309, 466; Min. Res. 1914, Pt. 1, p. 326; 1915, Pt. 1, p. 269. Geol. Surv. of Cal., Geol. Vol. II, p. 120.

Bonanza Group. Formerly consisted of 2 claims in Sec. 29, T. 18 S., R. 12 E., owned by Bonanza Quicksilver Mining Company. One claim has been abandoned and the other is now owned by Ramon Tirado, Hernandez. Assessment work is kept up and some good showings of ore are said to have been uncovered in doing this work.

Bibl: State Mineralogist's Report XV, p. 653; Bull. 78, pp. 100-101.

Bradford Mine (Cerro Gordo). In Secs. 3, 4, and 9, T. 15 S., R. 8 E. Last work by J. F. Tatham, lessee, Almaden Road, Los Gatos. Idle for past ten years.

Bibl: State Mineralogist's Report XV, p. 653; Bull. 27, pp. 131-133; Bull. 78, p. 101.

Butts Mine. Wm. Butts, owner, Pine Rock, via Tres Pinos. Located in Sec. 4, T. 16 S., R. 8 E. No production reported since 1915.

Bibl: State Mineralogist's Report XV, p. 654. Bull. 27, p. 133; Bull. 78, pp. 101-102.

Cannon Mine. A prospect in Section 4, T. 15 S., R. 8 E.

Bibl: State Mineralogist's Report XV, p. 654. Bull. 27, p. 133; Bull. 78, p. 102.

Cerro Bonito Mine. Patented property in Sec. 31, T. 15 S., R. 10 E., owned by Cerro Bonito Quicksilver Mining Company, Thomas Flint, president, Hollister, California. No activity for many years.

Bibl: State Mineralogist's Report XV, p. 654. Bull. 27, pp. 134-137; Bull. 78, pp. 102-103. Min. Res. W. of Rocky Mts., 1875, p. 14.

Don Juan and Don Miguel Mines. A patented property in Sec. 36, T. 18 S., R. 11 E., and Sec. 31, T. 18 S., R. 12 E., owned by W. A. Breen, Hernandez, California. Idle.

Bibl: State Mineralogist's Report XV, p. 654. Bull. 27, p. 137; Bull. 78, p. 103.

Florence Mack Mine. Owner, C. P. Smith, Hernandez, California. This property, consisting of 6 claims in Sec. 32, T. 18 S., R. 12 E., is on upper San Benito River 10 miles above Hernandez and not on Saw Mill Creek as erroneously stated in earlier reports. The owner and one man are carrying on development work, and have exposed considerable good ore. There is also about 7000 tons of low-grade ore on the dump, which could probably be concentrated. One flask of metal was produced during the summer of 1925, by retorting. The property is open for negotiations leading to its working.

Bibl: State Mineralogist's Report XV, pp. 655-657. Bull. 78, pp. 103-105.

French Ranch (see under Antimony).

Hernandez Quicksilver Mining Company. (Picachos Mine.) M. G. Ramirez, president, San Juan Bautista, Cal. The Picachos Mine is a patented property in Secs. 19 and 20, T. 18 S., R. 12 E., a producer in the past and containing a large tonnage of low-grade ore, indicated by panning tests at many points. The company lacks finances to install an adequate reduction plant and are open for negotiations with capital. Idle since 1916.

Bibl: State Mineralogist's Report XV, p. 658. Bull. 27, p. 145; Bull. 78, pp. 105-107. Geol. Surv. of Cal., Vol. II, p. 121. U. S. Geol. Survey Mon. XIII, pp. 309-466.

Lone Star Mine. A prospect on Los Muertos Creek, 18 miles south-east of Tres Pinos. Idle.

New Idria Quicksilver Mines, Inc. Ernest B. Dane, president; James D. Colt, secretary; Home Office, 6 Beacon St., Boston, Mass. San Francisco Office, Merchants Exchange Bldg., W. R. Moorehead, general manager; C. D. Richardson, superintendent, Idria, California. The New Idria property has produced approximately 98% of the recorded output of quicksilver from San Benito County, and it ranks second in total production of quicksilver in North America, being exceeded only by the New Almaden Mine in Santa Clara County.

The mine as of 1918 is fully described in Bulletin 78, but there have been some important changes since that publication was issued, including reorganization of the company, installation of additional rotary kilns, electric power line and many minor betterments.

A disastrous fire on June 20, 1920, destroyed the tramway terminals, ore bins and crushing plant, warehouse, blacksmith shop, old reduction furnaces and electrical equipment required for operation of the new rotary furnaces some of which were already installed.

This fire and the unsatisfactory condition of the quicksilver market due to the after-war slump in prices which carried them below the cost of production at most mines, resulted in the closing down of the mine in November, 1920. The New Idria Quicksilver Mining Company's affairs were liquidated and it was succeeded by the New Idria Quicksilver Mines, Inc., organized December 23, 1922. Rebuilding of the surface equipment and completion of the rotary furnace installation had been carried on in the meantime. Operations were resumed by the new company on April 25, 1923, and have been continuous ever since. Electric power for all purposes is now supplied by Coast Valleys Gas

and Electric Company over a new transmission line from King City, 56 miles distant, at 33,000 volts. This is stepped down to 440 volts at the substation by three 150-k.v.a. Malony transformers. From here a line carrying 2300 volts runs to Camp No. 2, the upper workings of the New Idria, where it is transformed to 440 volts.

There has been little change at Camp No. 3 (San Carlos workings) where mining by the quarry system continues with transportation by aerial tramway to the crusher ore-bins.

Camp No. 2 (upper workings of New Idria) is also an open quarry system operation, the ore being transported to the crusher ore-bins by a 3500 foot aerial tramway from No. 5 level.

Camp No. 1 is the main camp at the portal of No. 10, or 1000-foot level, the main haulage level of the New Idria. The crusher ore-bins are at the portal of this adit and transportation of ore is by 3-ton Edison Storage battery locomotives. All ore below No. 5 level is brought out through this haulage way. Two new levels have been opened up at 1100 and 1200 feet by a 2-compartment 55° incline shaft (winze) 200 feet from the vein on No. 10, or 1000-foot level. This shaft is 4000 feet from the portal and in the center of the mine. An 8" by 10" double-drum air-operated hoist is used. The lower levels of the New Idria are worked by overhead stoping with square-set timbering and back filling. The upper workings above No. 5 level are mined by quarrying as at the San Carlos.

An interesting new development at the upper workings (No. 3 level) of the New Idria is the installation of a Stevens-Adamson conveying system consisting of a 42" belt on 700 foot centers, fed by a 42" by 11' apron feeder. This conveyor will handle 350 tons per hour. It extends from the portal of No. 3 adit to the hanging wall of the vein which here dips 45° into the mountain. The object of this installation is to facilitate the removal of all overburden from the vein and expose all the old workings from the 300-foot level to the surface. It is estimated that this will require the moving of from 1,500,000 to 2,000,000 tons of material, but when completed it will permit extensive quarrying of this section of the orebody.

At the present time about 40% of all ore going to the furnaces is from quarrying operations and 60% is mined underground. It is expected that within a year these percentages will be reversed and eventually even a greater portion of the ore will be removed by quarrying, particularly during favorable weather, at a considerable reduction in mining costs.

The ore reduction equipment now consists of four 60" by 56' oil-fired rotary kilns with tank condensing system arranged in two units which can be operated singly or together as desired. All reject from the furnaces is transported to the dump by a 1200-foot aerial tramway equipped with a 1½-ton bucket with automatic dump, carried on a 2" steel cable.

No retorts of any kind are used. All dust, spray water, soot and other impurities drain to and are collected in a special tank fitted with a mechanical agitator which effects a separation of any mercury and it can be drawn off at the bottom. The remaining solids and water are passed through a series of three settling tanks. After settling this 'mud' is drawn from the last tank and spread out on a large steam-

heated concrete floor. When thoroughly dry it is returned in small lots by elevator to furnace feed bins and again passes through the kilns. After reaching a certain ratio the amount of such material to be retreated does not appear to increase, as might be expected.

The New Idria Mine is completely equipped with machine shop, timber-framing shop, crushing plant with series of belt conveyors from outside storage bins to feed bins at reduction plant, and other labor-saving machinery. Underground stations in the mine, the various tramway terminals, and the surface plants are connected by an independent telephone system. The mine office also has long distance connections. Three separate camps are maintained with a foreman and crew at each that have their own boarding house and other facilities. The company's trucks transport the flasks of quicksilver from Idria direct to San Francisco, making the trip in one day. From San Francisco it is shipped by boat to New York and marketed there. About 150 men are employed.

Bibl: State Mineralogist's Reports I, p. 26; IV, pp. 336, 339; VIII, pp. 483-485; X, p. 515; XI, p. 373; XII, p. 365; XIII, p. 599; XIV, p. 228; XV, pp. 660-668. Bull. 27, pp. 9, 22, 125-129, 138-145, 213, 214, 234, 241, 245; Bull. 67, pp. 33, 35; Bull. 78, pp. 14, 17, 34, 93, 95, 109-115, 236, 248-250, 275-276, 329, 339-342. U. S. Geol. Survey Mon. XIII, pp. 64, 189, 215, 291-308, 465. Min. Res. 1882 to 1922. Min. Res. W. of Rocky Mts. 1868, p. 264; 1869, p. 10; 1870, p. 759; 1871, pp. 58, 528; 1872, p. 523; 1873, pp. 10, 497; 1874, pp. 28, 37; 1875, p. 13. Geol. Surv. of Cal., Geol. Vol. I, pp. 57-60; Vol. II, pp. 113-120. Trans. A.I.M.E, Vol. XXXIII, p. 484.

Niesen Group. The former owner of this property consisting of two claims in Sec. 31, T. 18 S., R. 12 E., and Sec. 36, T. 18 S., R. 11 E., John Niesen of Hernandez is deceased. The property is idle.

Bibl: State Mineralogist's Report XV, p. 669; Bull. 78, p. 120.

Stayton Mine. (See under Antimony.)

Tirado Group. Jose Tirado, Hernandez, owner. Consists of two claims in Sec. 18, T. 18 S., R. 12 E. A small production was made here in 1916 and 1917. Idle except for assessment work.

Bibl: State Mineralogist's Report XV, p. 670. Bull. 78, pp. 121-122.

Tirado and Shear Group. Owners, S. Tirado and Wm. Shear, Hernandez, California. This property consists of two claims on a new discovery made in 1925. The deposit is situated in the serpentine area south of Sampson Peak on a branch of Clear Creek $2\frac{1}{2}$ miles in an air-line southwest of New Idria. There is reported to be 6 feet of good ore. One flask of quicksilver was recovered with a 2-pipe retort from an open cut on the outcrop, in doing assessment work. The deposit was not visited, but Mr. Tirado who has been long familiar with the properties in this district states that it is a very good looking prospect.

STONE INDUSTRY.

(CRUSHED ROCK, SAND AND GRAVEL.)

There is only one large operator in the county producing crushed rock and washed sand. Aside from this there has been some 'bank run' gravel and sand taken from gravel banks and from the bed of San Benito River, which has been used chiefly for filling and road work.

Berberich Gravel Pit comprises an area of six acres on the edge of town, owned by C. F. Berberich of Hollister. The deposit is a residual hill consisting almost entirely of gravel and clean sand with a few cobbles. There is scarcely any overburden. A depth of 110 feet of this material is said to have been shown by wells drilled into it indicating that the supply is almost unlimited. There is no screening or washing equipment and the material as dug is not suitable for important concrete work.

County Pits. The county has a gravel pit a few miles south of Hollister, from which road material has been obtained, and small screening plant above the road with loading chute for filling trucks at a point about half way to Emmet on the Idria road.

Granite Rock Company, A. R. Wilson, president and manager; A. J. Wilson, vice-president and engineer; C. E. Bloom, secretary; John E. Porter, sales manager. Office: Watsonville, California. D. W. Swearinger, plant superintendent, Logan, California.

The plant, also known as Logan Quarry, is located at Logan on the Coast Division of the Southern Pacific Railroad 93 miles south of San Francisco.

Granite forms the wall of Pajaro River Canyon at this point and rises about 300 feet above the level of the railroad tracks. The company owns 600 acres in all, about 100 acres of which can be worked. A face of granite has been opened up approximately one-half mile long but at present only about 1200 feet of it is being worked. The bench on which the steam shovels work and the quarry track is laid, is 100 feet vertically above the main line railroad tracks. From this working level the face rises 180 feet. There is an overburden consisting of approximately 35 feet of adobe, clay, sand and fossilized clam shells which is removed by hydraulicking. To do this water is pumped from Pajaro River by a 7" by 10" triplex Deane mine pump through two 4-inch pipe lines under 300-pounds pressure to the top of the deposit, a total elevation of over 300 feet. The water is delivered to a 3" monitor and the material sluiced southeast down the mountain side to an impounding dam. It requires continuous hydraulicking to keep the overburden back from the slides caused by blasting. No drilling on top of the exposed rock is necessary. Air operated Sullivan drills are used to toe-hole or snake-hole the base of the quarry face to a depth of about 22 feet. These holes are sprung so they will contain a charge of from 5 to 8 boxes of 40% powder. Several holes are shot simultaneously bringing down the whole face of the quarry in sizes

that can be handled by the power shovels with some little additional blasting or bulldozing.

Equipment consists of one Model 50 Marion oil-fired steam shovel, one Model 20 Marion and one electric revolving shovel with $1\frac{3}{4}$ -yard bucket. In addition there are fifty 4-yard western dump steel-lined cars and four 10" by 16" Porter oil-burning locomotives, 36" gauge. At the storage yards there is one 12" by 18" Porter standard-gauge switching locomotive, one 30' Ohio locomotive crane and 100-ton track scales.

The broken material is loaded in trains of 12 cars each for delivery to the crushing plant.

The crushing plant is unusual in that it consists of two parallel units practically alike called the No. 8 and No. 7 $\frac{1}{2}$ plants which may be operated as one or as distinct units. Both units are fed through long side-hill chutes lined with special steel T-bars, their lower ends having bar grizzlies 12' by 30' with 2" spacing. Each chute will hold



Plant of Granite Rock Company at Logan, San Benito County. The quarry face shows above and to the left of the buildings.

several trainloads of rock. Material passing through the grizzlies is removed by belt conveyors to a 48" by 16" screen from which rock $\frac{3}{4}$ " and over is recovered and the fines transferred to a waste bin on the track-loading level, or elevated to the quarry-floor waste bin. This material consists mainly of rotten weathered rock and was formerly given away but is now sold for special uses. It is called Base rock and is particularly suitable as a water bound macadam road material. Over 170,000 tons of this was produced in 1925.

The crushing equipment in the No. 8 unit consists of a No. 8 McCully gyratory, followed by a 48" by 10' scalping screen, two No. 4 and one No. 2 Telsmith regrinders, another 48" by 10' scalping screen, two electric Hum-mer screens and two 60" by 20' sizing screens.

The No. 7 $\frac{1}{2}$ unit has a No. 7 $\frac{1}{2}$ McCully gyratory followed by a 48" by 10' scalping screen, one No. 4 Telsmith reduction crusher in closed circuit, an electric Hum-mer screen and two 48" by 16' sizing screens.

A new regrinding plant is connected by a conveyor belt with the two units of the primary plant and can draw from any bunker in the two units. The conveyor belt discharges into a 250-ton feed bunker which discharges to three 6" Allis-Chalmers McCully type regrinding crushers, the discharge of which passes to five Link-Belt shaking screens. The equipment permits the production of a large number of stock sizes. These include: $2\frac{1}{2}$ "; 2"; $1\frac{1}{2}$ "; 1"; $\frac{3}{4}$ "- $\frac{1}{2}$ "; $\frac{1}{2}$ "- $\frac{3}{8}$ "; $\frac{3}{8}$ "- $\frac{1}{4}$ "; $\frac{1}{4}$ "- $\frac{1}{8}$ "; $\frac{1}{8}$ "-20 mesh; 20 mesh-40 mesh and $\frac{1}{8}$ " to dust.

Beside crushed granite rock the company also produces washed sand. This is pumped from the bed of Pajaro river by a suction dredge to a 14,000-gallon tank and screened through a $\frac{3}{8}$ " square-mesh revolving screen. The sand plant has a capacity of 6 cars in 8 hours. Operations at Logan quarry began in a small way in 1900. The capacity of the crushing plant is now 2000 tons in 8 hours and fifty men are employed.

The rock is a tough dark-colored basic granite, but the mass as a whole is quite thoroughly fractured as the San Andreas fault line passes through it. A blast may bring down anywhere from 500 to 50,000 tons depending on the condition of the bank. A large slide during the past year buried and completely wrecked one of the steam shovels.

Bibl: State Mineralogist's Report XV, p. 671. Rock Products, February 9, 1924.

STRONTIUM.

A vein of celestite (strontium sulphate) about three inches in thickness was cut years ago in some of the old workings at the Butts quick-silver mine near Pine Rock. A sample of this is in the possession of H. V. Underwood, of Hollister. It is the only known occurrence of strontium mineral in the county. The deposit is doubtless too small to have a commercial value.

VOLCANIC ASH.

H. V. Underwood, Hollister, California, reports the occurrence of a bed of white volcanic ash on Tres Pinos Creek, about 10 miles south of Paicines in the Emmet district. Undeveloped.

LOS ANGELES FIELD DIVISION.

W. BURLING TUCKER, Mining Engineer.

IMPERIAL COUNTY.**Introduction.**

Imperial County formed part of San Diego County from the organization of the latter in 1850 to August, 1907, when it was created into a separate county by vote of the supervisors of San Diego County, under an act of the legislature giving them that power.

The principal industries of Imperial County are agriculture, stock raising and dairying. Its mineral resources are varied and extensive and the rapid and continued growth of the towns of Imperial Valley and the manufacturing industries of the Pacific Coast have led to the development of deposits of structural and industrial materials throughout the county.

Description.

Imperial County is bounded on the east by the State of Arizona, north by Riverside County, west by San Diego County and south by Mexico. Its area is 4089 square miles, with a population of 43,383 (1920 census). The county is served by two railroads, the Southern Pacific and the San Diego and Arizona. The transcontinental line of the Southern Pacific Railroad enters the county on the north near Durmid on the eastern shore of the Salton Sea and runs southeasterly through the county to Yuma, Arizona. From the main trunk line a branch from Niland runs through the Imperial Valley to El Centro and Calexico and continues on into Mexico, connecting Mexicali with Yuma. The San Diego and Arizona Railroad enters the county from the west, connecting San Diego with Imperial Valley at El Centro. Two main paved highways afford easy access to the county from the north. The highway between San Diego and El Centro forms part of the coast route from Los Angeles to Imperial Valley, Yuma and Phoenix. The other route from Los Angeles is over the Valley Boulevard by way of Beaumont and Banning to Brawley and El Centro. The Blythe-Glamis route to Yuma and Imperial Valley is one of the main desert roads, which enters the county from the northeast at Palo Verde and runs southwest to Glamis, from which point the road follows the railroad north to Niland.

Physiography.

The most important feature of Imperial County is the broad and nearly level expanse of the Colorado River Delta which separates the Gulf of California from the Salton Basin and is known as Imperial Valley. The Salton Sea region is one of the interesting topographical features of the county. Diagonally across the region, from southeast to northwest, it extends as a great trough whose lowest point is nearly 300 feet below sea level. On the west side of this deep trough rise the Peninsular Mountains whose culminating points are 10,000 feet above sea level. On the east side is a desert containing irregular ranges and undrained basins ranging in altitude from a few hundred feet to 5000 feet or more,

The eastern border of the territory is formed by the Colorado River whose waters flow through a low valley and finally spread out over a huge delta as they enter the Gulf of California.

The surface of the central portion of the Salton Basin is very even and nearly flat; about its borders are alluvial slopes. In a number of places rock masses protrude above the even surface of the basin as rocky islands project out of the sea. Such island-like features are formed by Borego, Superstition and Carrizo mountains, the Cargo Muchacho Mountains, Pilot Knob and a number of volcanic buttes 100 to 200 feet high south of Salton Sea.

The Sand Hills constitute an important feature of the physiography of Salton Basin. The sand hills east of Imperial Valley constitute the largest belt of dunes in this region and also one of the largest in the United States. They extend southeastward from the vicinity of Amos and terminate a few miles beyond the Mexican boundary, being about 40 miles in length and from two to six miles in width. The crests of some of the dunes rise in places 200 to 300 feet above the land on either side.

Another interesting feature of the Salton Basin is the old beach line which lies 40 to 50 feet above sea level and encircles Imperial Valley, the Salton Sea and part of Coachella Valley south of Indio.

Geology.

The most useful references on the geology of the region are Blake's original description of the Salton Basin,¹ Mendenhall's papers on Coachella Valley and Carrizo Creek,² Fairbank's report,³ and U. S. Geol. Survey Water-Supply Paper No. 497, 'The Salton Sea Region, California,' by John S. Brown. In the following notes on the geology of Imperial County, excerpts are taken from the last-named paper:

According to most geologists who have worked in this region, the oldest rocks are probably of pre-Cambrian age. The pre-Cambrian rocks occur mainly in the desert mountains in the region between the Salton Basin and the Colorado River. They are commonly flanked by Tertiary or later sediments about the mountain borders and in large areas they are covered or intruded by Tertiary volcanic rocks. The rocks that can most certainly be referred to as the oldest series consist of granite and granitic gneiss. In this series probably belong the granite and schist that compose most of the Cargo Muchacho Range and the granite, slate and schist that form the basements of the Picacho Hills and the eastern part of the Chocolate Mountains. On the western border of the desert in Carrizo Mountain, and on the top of Fish Mountain in the Carrizo Creek region, are beds of marble and some schist and sandstone which have been referred by Mendenhall and Fairbanks to the Paleozoic, with suggestion that they may be Carboniferous. Marble, schist and gneiss of undetermined age in the Santa Rosa Mountains may belong to the same series of rocks as the Carrizo Mountain district.

¹ Blake, W. P., Pacific Railroad Reports, Vol. V, 1853.

² Mendenhall, W. C., Ground waters of the Indio Region, Calif., with a sketch of the Colorado Desert: U. S. Geol. Surv., Water Supply Paper No. 225, 1909.

³ Fairbanks, Harold W., Geology of San Diego, Orange and San Bernardino Counties: State Mineralogist Report XI, pp. 76-120, 1892.

Tertiary Sedimentary Deposits.

Sedimentary beds, believed to be of Tertiary age, occupy extensive areas along the southwest and northeast sides of the Salton Basin and presumably underlie practically the entire basin. The largest and best-known exposures southwest of Salton Sea are in Carrizo Creek Valley, around Yuha Well, south of the Santa Rosa Mountains and northeast of Superstition Mountain and Borego Mountain, and on the north side of Fish Mountain. The Tertiary beds consist of soft, poorly consolidated conglomerates, sand and clay containing in places a large amount of gypsum and some other saline materials. Part of the Tertiary beds in the region are marine and part terrestrial. Marine beds cover large areas in the Carrizo Creek region where they contain abundant marine fauna and are represented around Carrizo Mountain and north of Fish Mountain by chemical deposits such as gypsum and strontianite which were evidently deposited in water.

Tertiary and Quaternary Volcanic Rocks.

The volcanic rocks of this area are probably mostly Tertiary; some of them are Quaternary. They occur as flows interbedded with sedimentary beds in the Carrizo region, around Superstition Mountain, and in Iris Pass. The lavas are most prominent in the Chocolate and Palo Verde mountains. The Palo Verde Mountains are entirely volcanic, being chiefly a mass of andesitic or rhyolitic flows. The Chocolate Mountains, from one end to the other, exhibit a great mixture of andesitic and rhyolitic flows with possibly syenite and trachyte in the west end.

The only volcanic material of unquestionably Quaternary age in this region is found in the vicinity of the mud volcanoes southeast of Salton Sea where three or four small buttes of black obsidian protrude through the Quaternary silt.

Quaternary Deposits.

The Quaternary deposits immediately underlie nearly all the lowlands and have the largest areal extent of all the rock formations. They underlie the larger part of the Salton Basin and practically all of the Colorado River Valley. The valley fill consists of sand, gravel and clay washed down from the hills and mountains.

Mineral Resources.

The last general report on the mines and mineral resources of Imperial County appeared in Report XIV of the State Mineralogist (1913-1914). The writer of the present article spent from October 15, 1925, to January 15, 1926, on a survey of the county in an endeavor to collect up-to-date information on mining activities and mineral resources.

Appreciation is here expressed for the courteous treatment and cooperation of operators, owners and the Chambers of Commerce throughout the county. Acknowledgments are especially due C. F. Stahl of the Pacific Portland Cement Company; Frederick A. Ballin, Columbia Cement Company; P. J. Kane, of Ogilby, for their cooperation and for the valuable information which they furnished.

During 1924 Imperial County produced seven mineral substances having a total value of \$139,908 as compared with the 1923 output worth \$264,733. It ranks as the forty-sixth county in the state's mineral production. Imperial County contains deposits of clay, copper, cyanite, gold, gems, gypsum, lead, manganese, marble, mineral paint, pumice, salt, silver, sodium, strontium, sulphur and tale, largely undeveloped. The attached table gives its complete recorded output and value of the mineral production from 1907 to and including 1924.

IMPERIAL COUNTY, 1907-1924.

Year	Brick		Gold, value	Silver, value	Miscel- laneous stone, value	Miscellaneous and unapportioned		
	M	Value				Amount	Value	Substance
1907.....	1,000	\$10,000						
1908.....	2,225	22,250	\$5,848	\$123		375 lbs.	\$51	Copper.
1909.....	2,000	20,000	59,705	524				
1910.....	1,680	10,078	87,341	237				
1911.....	1,200	7,000	97,855	189				
1912.....	3,250	20,000			\$10,000			
1913.....	5,500	44,000	31,700	94	12,000	750 cu. ft.	7,260	Marble.
1914.....	4,900	29,400	210,428	8,961		13,081 lbs.	1,730	Copper.
1915.....	2,958	17,916	14,369	42	40,095	65 lbs.	11	Copper.
1916.....	s		23,338	155	34,834		5,000	Other minerals
							47,006	Brick, copper, lead, pum- ice, strontium.
1917.....	and tile	19,260	919	5	65,660	1,907 tons	38,140	Manganese.
							5,416	Copper, potash, pumice.
1918.....	and tile	11,670	247	1,248	34,787	1,241 tons	46,900	Manganese.
1919.....	s			8,607	63,900		14,840	Copper, lead, pumice.
1920.....	s			2,183	127,412	624 tons	67,936	Brick, lead, pumice, salt.
1921.....	654	6,363	537	920	171,173		16,500	Pumice.
1922.....			350	18,024	154,560		23,787	Other minerals.
							3,825	Other minerals.
1923.....					101,833		15,805	Brick, gypsum, lead, marble, pumice.
							162,900	Brick, gold, gypsum, pumice, silver, soda (salt cake).
1924.....			258	1	78,032		61,617	Brick, gems (dumortierite), gypsum, pumice.
Totals..		\$217,937	\$532,895	\$41,313	\$894,286		\$518,734	

¹Imperial County was created August, 1907, from a part of San Diego County.

²Includes production of San Diego County.

³See under 'Unapportioned'.

METALS.

COPPER.

The occurrence of copper ores in this county is limited to the Picacho and Paymaster districts, and the Fish Mountains. In the former district surface stains of copper are widely disseminated through a considerable area three miles southeast of Picacho. It is reported that some drilling was done here in the past but the results were not encouraging. A number of claims have been located in this area, which are held by annual assessment work.

In the Paymaster district, the chief mineralization noted is in Secs. 23 and 26, T. 12 S., R. 20 E., S. B. B. & M., 16 miles east of Glamis. The oxides and carbonates of copper occur along shear zones in schists and along fractures in the monzonite and in one place the occurrence of copper sulphides was noted, finely disseminated in the monzonite. A number of claims have been located in this area and considerable surface prospecting has been done along the highly mineralized zones. On the west slope of Fish Mountains copper occurs as copper oxides and carbonates.

Cambell Group of Claims are located on the west slope of Fish Mountains, 15 miles northwest of Coyote Wells. The ore occurs as oxides and carbonates. Owners, George Cambell and associates of Seely.

Cave Man Group of Claims comprises four claims; Cave Man, Dixie Queen, Mary Louise and P. J. K., located in Sec. 26, T. 12 S., R. 20 E., S. B. B. & M., 16 miles east of Glamis, in the Paymaster mining district. E. B. Dykes, 861 West Tenth Street, Riverside, owner. The principal development work has been done on the Cave Man claim.

The formation is schist, quartzite and monzonite. The ore occurs along the contact of schist and quartzite and strikes N. 30° W. In the vicinity of this contact for a distance of 20 feet the rock is mineralized with malachite and azurite. Samples taken from the workings are reported to assay from 5 to 13% copper, with gold and silver values. Developments consist of open-cuts and a short tunnel driven north-east. Two men employed.

Picacho Copper Deposit. This deposit is located two miles southeast of the village of Picacho and about 3 miles east of Picacho Peak.

The schists in this area strike northwest and dip 50° southwest. Surface stains of copper are widely disseminated throughout this belt of schist. The principal mineralization appears for a mile in length and about one-quarter of a mile in width. About 160 acres are held by location by different individuals of Picacho and Yuma, Arizona. The mineralization is along shear zones in the schist that strike northwest. The schist is heavily stained with malachite. On the west side of a small butte considerable development has been done, there being five shafts having depths of 50 to 75 feet and a large number of trenches and open cuts exposing considerable ore. A number of years ago three holes were put down at different points on the deposit but it is said that the results were not encouraging. On the north end of the deposit are a number of siliceous outcrops that are mineralized with chalcopyrite.

Volunteer Group of Claims comprises eight claims located in Sees. 23 and 26, T. 12 S., R. 20 E., S. B. B. & M., 16 miles east of Glamis, adjoining the Cave Man Group on the northwest, in the Paymaster mining district. Owner, P. J. Kane, of Glamis.

These claims were located in 1917 and since that date considerable development has been done, consisting of prospect shafts and open-cuts. The formation is monzonite and schist. The chief mineralization occurs along fractures in the monzonite which strike north and dip 80° east. The fractures are heavily mineralized with malachite and azurite and in one prospect hole the monzonite shows copper sulphides disseminated through the rock.

The principal development work has been confined to a small rounded hill near the camp. On the south slope of this hill several shafts have been sunk to depths of eight to ten feet, all of which have developed some ore. The main working shaft has been sunk to a



Workings on Volunteer Group of Claims in Chocolate Mountains, Imperial County.

depth of 70 feet, on a fracture in the monzonite which strikes north and dips 70° east. The fracture is mineralized with azurite and malachite over a width of six feet. Samples taken from these workings are reported to assay from 5% to 10% copper and \$5 in gold and silver. Equipment consists of a gasoline engine, crusher and small leaching plant. Two men are employed.

GOLD.

Gold is widely scattered over the desert region of the county and has probably been mined to some extent in every mountain range. It occurs as placer gold; in veins of quartz in granitic rocks and in mineralized zones in schist. The placers have usually been either too low-grade or too far from water to be profitably worked. The gold deposits that have been productive in the past occur in the southeastern corner of the county, in the mountain ranges between the line of the Southern Pacific Railroad and the Colorado River.

The principal producing districts are located in the Cargo Muchacho Range which trends northwest and in the Picacho range of mountains which also has a northwest trend along the Colorado River.

The Cargo Muchacho Range is made up of metamorphic gneiss and schist cut by pegmatite dikes and lies three to four miles northeast of the line of the Southern Pacific Railroad, its southeastern extremity being nine miles from Yuma. In the northern section of this range, sometimes called the Hedges Mountains, of which the summit measures 2225 feet, is the Hedges district and in the southern section is the Cargo Muchacho district, the highest peak having an altitude of 2130 feet. Many auriferous veins have been found along the ridges of this range and in all the gulches of the range and washes leading from them, placer gold has been abundant.

The Picacho range of mountains, of which the chief summit is El Picacho, attains a height of 1945 feet. The range is made up of volcanic lavas, tuffs and conglomerates. The volcanics are underlain by metamorphic schists and gneisses which contain the chief gold deposits and are probably of the same age as those of the Cargo Muchacho Range. Mining has been carried on in the Picacho district almost continuously since 1857 but since 1910 there has been no great activity and very little production.

In the Cargo Muchacho Range mining has been done on a large scale at various times since 1879. The different productive mines were under operation more or less continuously until 1915 when operations came to a standstill on account of the World War and practically all mill and other equipment, including pipe lines from the Colorado River, were removed from the American Girl and other mines of the Hedges district and sold for junk. At present writing nothing is being done in these districts except development work on the various claims held by their owners.

Dry Placers.

The dry placers are for the most part located in the eastern part of the county, chiefly in the Colorado desert region. These are probably the earliest known sources of gold in the state, having been worked in the early days by the Mexicans and Indians. The most productive deposits are known as the Mesquite, Picacho and Pot Holes or Laguna. The gold in these districts came from the quartz stringers in the schists and slates of the Cargo Muchacho and Chocolate ranges of mountains, being brought down and concentrated in the different gulches and washes by erosion. The Pot Holes district, from which a reported production of \$2,000,000 has been taken out, is near Yuma. It is stated that as many as 400 or 500 Mexicans were working with hand-washing machines for a period of several years. Much gold is reported to have been taken from the placer workings at Picacho and Mesquite in the early days. It is stated that the gravel of the Picacho basin has an average value of 35 cents per yard. A number of attempts have been made to work these gravels by dry placer machines but with poor success.

Mines.

American Girl. This property is located five miles northeast of Ogilby, in Sec. 17, T. 15 S., R. 21 E., S. B. B. & M., in the Cargo Muchacho Range of mountains. Elevation, 700 feet. Owner, Imperial Reduction Company; R. Schiffman, president; Mac D. Snowball, secretary; office, Pasadena.

The mine was discovered in 1877 and worked until 1915 when operations were suspended and all equipment removed from the property. The ore is quartzose vein matter and silicified schist, carrying iron pyrites which contain gold occurring in granite gneiss and schist. The vein worked had a maximum width of 40 feet. It strikes northwest and dips 35° southwest. Development consists of an incline shaft sunk on the vein to a depth of 1000 feet, with levels at every 100 feet. Idle.

Bibl: State Mineralogist's Reports XIII, p. 331; XIV, pp. 728-729.

Blossom Mine comprises three claims located in the Cargo Muchacho Mountains, at an elevation of 400 feet, four miles east of Ogilby, a station on the Southern Pacific Railroad. Developments consist of an incline shaft 280 feet deep, located one mile southwest of the American Girl. The ore on the dump is similar to the American Girl. Owner, John McEwen of Ogilby. Idle.

Bibl: State Mineralogist's Reports XII, p. 238; XIII, p. 332; XIV, p. 729.

Butterfly Group of Mines comprises seven claims, located east of the American Girl and four miles northeast of Ogilby, a station on the Southern Pacific Railroad, in the Cargo Muchacho district. Elevation, 800 feet. Owner, S. C. Samson, of Ogilby. The vein runs northwest and dips southeast. An incline shaft has been sunk to a depth of 325 feet on the vein. Idle.

Cargo Muchacho Mine is four miles east of Ogilby, a station on the Southern Pacific Railroad, about 1½ miles southeast of the Blossom Mine in the Cargo Muchacho Mountains. The vein occurs in hornblende schist and is from two to eight feet in width. Its strike is north and the dip from 45° to 50° east. Developments consist of two shafts, one being 500 feet deep, the other 200 feet. Idle.

Bibl: State Mineralogist's Reports VI, p. 81; XI, p. 385; XII, p. 239; XIII, p. 334; XIV, p. 729.

Desert King Mine comprises four claims known as Desert King, Desert Queen, Highland Chief and Red Hawk, and is located in Sec. 12, T. 15 S., R. 20 E., S. B. B. & M., in the Hedges mining district, in the Cargo Muchacho Mountains, five miles north of Ogilby, a station on the Southern Pacific Railroad. Owners, M. B. Patton, C. S. Walker and B. F. Harrison, of Glendale, California.

The main vein, which strikes N. 60° W and dips 55° SW., has a width of from three to five feet. It occurs in a micaceous quartz schist which is cut in all directions by pegmatite dikes that vary in width from a

few inches to several feet. The ore is a quartzose schist, stained with copper and is said to average \$15 per ton in gold.

The development on this vein consists of a shaft sunk on the vein to a depth of 150 feet. At a depth of 75 feet a drift has been driven east 100 feet and also west 125 feet. From the bottom of this shaft is a drift east 50 feet and west 50 feet. A cross-cut tunnel is driven north 75 feet and this connects with the shaft on the 75-foot level. About 300 feet west of these workings, at a lower elevation, a cross-cut tunnel has been driven N. 60° E. for 300 feet. At 100 feet from the portal of this tunnel a small ore shoot is cut which was stoped to the surface. At this point a drift, which evidently is not on the vein, has been driven north 200 feet and there is also a drift east 100 feet but no ore has been developed. Ore stoped is said to average \$5 to \$20 per ton.

Northwest of these workings, on the opposite slope of the ridge, considerable prospecting has been done on a parallel system of veins. On one of these veins is an incline shaft 30 feet deep and also a tunnel 30 feet in length. The vein is 12 inches to three feet wide, strikes northeast and dips 35° southeast. A 10-stamp mill was formerly on the property but this was removed in 1915. The only equipment consists of a head frame, ore bins and framework of the mill. Two men are employed on development work.

Duncan Mine. It comprises five claims located $1\frac{1}{2}$ miles northwest of Pot Holes or the Laguna Dam. Owner, W. H. Trenchard, of Laguna. The vein, which has a width of 7 feet, occurs in granitic gneiss. Ore milled from the vein is said to have plated \$14 per ton. Development consists of an incline shaft sunk on the vein to a depth of 200 feet. Idle.

El Lucero Group of Claims contains five, known as El Lucero, Cuidadela, La Fortuga No. 1 and No. 2, and Missing Link, located 17 miles northwest of Yuma and about 4 miles from the Colorado River in the Picacho mining district. Elevation 450 feet. Owners, Abel Ochoa and Philip Hess, of Yuma, Arizona.

The veins, which have widths of 2 to 4 feet, occur in a granitic gneiss. The veins strike N. 20° W. and dip 40° west. The principal development has been on El Lucero claim. Two incline shafts have been sunk to a depth of 30 feet. The quartz vein is oxidized, being stained with iron oxides and some copper stain. Ore shoot developed is 30 feet long with an average width of two feet. On La Fortuga claim, about 700 feet north of these workings, a tunnel is being driven south to intersect the vein at a lower elevation. On the Missing Link Claim, which is located one-half mile north of El Lucero workings, considerable surface prospecting has been done on a parallel vein. One man employed.

Erma Mine, formerly owned by the Erma Mining Company, comprises twelve claims located in the vicinity of the Mesquite Placer, in Sec. 21, T. 13 S., R. 19 E., S. B. B. and M., about 7 miles northeast of Glamis. Elevation 950 feet. The gold occurs in pockets in some quartz veins in the schists. These veins are about 3 feet wide. Development consists of a number of shafts from 50 to 100 feet deep. Claims at present held under names of different locators.

Gold Basin Mine comprises four claims located in Sec. 3, T. 12 S., R. 20 E., S. B. B. and M., 18 miles northeast of Ogilby, a station on the Southern Pacific Railroad and $1\frac{1}{2}$ miles east of the Glamis-Palo Verde road, in the Chocolate Mountains. Owner, C. A. Gibson of Brawley. The mine was discovered by Thomas Dunn in 1915 and worked in 1917, when a rich lens of ore that is reported to have produced \$500 in gold was encountered.

A series of parallel veins of quartz 12 to 18 inches in width occur in diorite. These veins strike northeast and dip from 60° to 70° to the southeast. A number of shallow shafts have been sunk on the different veins. The deepest of these is 100 feet. North of this shaft is also a tunnel which has been driven south 50 feet to intersect a quartzite dike that strikes east. The quartz is copper-stained and is said to carry values in gold from \$25 to \$50 per ton. Equipment consists of cars, track and arastra. Only annual assessment work is being done on the property.



View of Cargo Muchacho Range of Mountains, Tumco District.
Ogilby, Imperial County.

Golden Cross Group of Mines. This group of mines is located on the western slope of the Cargo Muchacho Range, in Sec. 1 and 12, T. 15 S., R. 20 E., S. B. B. and M., and in Sec. 6 and 7, T. 15 S., R. 21 E., S. B. B. and M., in the Hedges mining district $4\frac{1}{2}$ miles north of Ogilby, a station on the Southern Pacific Railroad. Elevation 700 feet. The property originally comprised twenty claims but the principal workings were on the Golden Cross, Golden Crown, and Queen claims.

The mines were operated from 1910 to 1914 by the United Mines Company of Los Angeles and the company changed the name of the camp to Tumco. During 1916 the mines were operated by the Queen Mining Company of Ogilby when 30 stamps of the mill were run, crushing 50 tons per 24 hours.

The properties were equipped with hoisting and compressor plants, also 100-stamp mill and cyanide plant. This equipment, including

pumping plant and pipe line from the Colorado River, was removed from the property in 1917 and sold as junk. At the time the district was visited by the writer, the camp was practically abandoned. These properties are held by location as the *Good Luck Group*, comprising six claims, by M. B. Patton, C. S. Walker and B. F. Harrison, of South Pasadena, California.

The formation in the vicinity of these mines is a micaceous quartz schist, in part feldspathic, which is cut in all possible directions by pegmatite dikes, varying from a few inches to several feet in width. The orebodies are in quartzose schist or gneiss and the mineralization parallels the stratification in certain layers of the schist. The silicified hornblende schist carrying gold, dips about 30 to 35 degrees southeast with a strike N. 35° E. The veins are from 2 to 25 feet in width. The ore shoots mined varied in width from 15 to 25 feet. The country is extensively faulted and at least two systems of faults exist. One of these, a major system, trends nearly northeast and the minor system has a trend nearly east.

There are three incline shafts and glory holes known as Golden Queen, Golden Crown and Golden Cross. The Golden Cross is sunk on an incline of 37° to a depth of 1200 feet. The Golden Queen shaft is sunk on an incline of 35° to a depth of 1000 feet and the Golden Crown to a depth of 1100 feet. The Golden Crown and Golden Cross shafts are on the same vein system, while the Golden Queen is on a monoclinal fault block north of that which contains the other two and it is probable that the two ore-bearing strata were once continuous, faulting in the major system having displaced and cut off the Golden Queen block from that containing the others.

The total underground workings are said to comprise over eight miles of drifts. Levels were driven from the different shafts every 100 feet. Considerable area of the mineralized schists was mined by the glory hole method above the three shafts. It is reported that the ore mined from the glory holes had values of from \$1.50 to \$2.50 per ton, while that mined underground ran from \$4 to \$8 per ton. The production from this group of mines amounted to \$2,000,000.

Bibl: State Mineralogist's Reports XII, p. 240; XIII, p. 337; XIV, pp. 726-728.

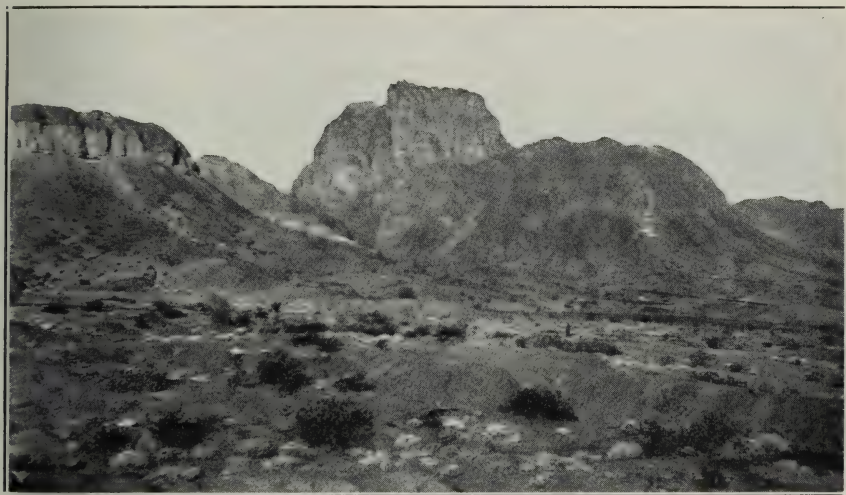
Mendeville Group of Claims. These claims are located one mile east of the Picacho Basin Mine in the Picacho mining district. Elevation 560 feet. Holdings comprise two claims, owned by J. Mendeville, of Yuma. Under option to L. M. Tobin, of Yuma, Arizona. The orebody is in a quartzose schist or gneiss and a silicified country rock which contains gold. The vein of silicified schist is 50 feet wide and strikes north with a dip of 60° west. The orebody has been developed by an incline shaft to a depth of 75 feet and a crosscut east 50 feet and drift south along contact of andesite and schist 25 feet. A vertical shaft about 50 feet deep connects with this south drift. It is stated that a sample taken from the full length of the cross-cut had a value of \$7 per ton in gold. Idle.

Mesquite Placer is located in Sec. 21, T. 13 S., R. 19 E., S. B. B. and M., about 7 miles by road northeast of Glamis. Elevation 950 feet. The gravels lie along the washes of the present water courses

from the Chocolate Mountains which drain into the bed of a dry lake against the sand hills, ten miles to the south. The placer gravels are in places fifteen feet deep but are not continuous and probably the average depth would not be over six feet. During the early work on these placers, water was packed from Glamis and the gravels panned and run through rockers. Some dry placering has also been done. Although the deposits are not continuous but cut through by arroyos, they vary in width up to one-half mile and extend for about two miles along the flank of the Chocolate Mountains. Much gold is reported to have been taken from these workings in the early days and probably considerable areas remain which could be worked if water could be secured.

Bibl: State Mineralogist's Report XIV, p. 731.

Ogilby Group of Mines comprises seven claims located in the Cargo Muchacho Mountains, four miles northeast of Ogilby, adjoining the



Dry placers and view of Picacho Peak. Picacho Basin, Imperial County.

American Girl Mine on the west. Elevation 700 feet. Owners, S. C. Samson and Thomas Johnson, of Ogilby.

The ore occurrence is similar to that on the American Girl Mine. The orebodies are in a quartzose schist or gneiss, carrying iron pyrites which contain gold.

Developments consist of six shafts, the deepest being 500 feet. The veins strike northwest and dip 35° to 40° to the southwest. The present development is confined to sinking a new incline shaft. A 5-ton Ellis ball mill is being installed. Two men are employed.

Padre and Madre Mine is in the Cargo Muchacho district, four miles east of Ogilby, a station on the Southern Pacific Railroad and adjoins the Blossom Mine on the southeast. Owner, Mrs. S. B. Wright, of San Bernardino.

Bibl: State Mineralogist's Reports XII, p. 242; XIII, p. 343.

Pasadena and South Extension Mine comprises two claims located in Sec. 20, T. 15 S., R. 21 E., S. B. B. and M., in the Cargo Muchacho district, four miles north of Ogilby, a station on the Southern Pacific Railroad. Developments consist of a shaft 100 feet deep. Owner, William Borthwich and associates of Ogilby, California. Idle.

Bibl: State Mineralogist's Reports XI, p. 386; XII, p. 242; XIII, p. 343; XIV, p. 729.

Peg Leg Mine. It is located on the eastern slope of the Chocolate Mountains, about 15 miles west of Niland.

The vein has a width of two feet and strikes N. 30° W., dip vertical. The country rock is granite. The development work consists of two shafts sunk on the vein, the north shaft being 150 feet deep, and 300 feet south of which is another shaft 75 feet deep. The vein quartz is iron stained. It is also stained with copper. Idle.

Picacho Basin Mine (Placer). It is 25 miles north of Yuma and about 5 miles south of Picacho P. O. The basin consists of low, rolling hills covered in part by washed gravel and detritus from the neighboring hills. These superficial deposits are gold-bearing and have been worked by Mexicans and Indians for years, and recently by dry washing machines. The gravels have been worked along the arroyo, between the Picacho Basin mine and the village and the ground is now owned by the Ridgeway Estate, of Philadelphia, Pennsylvania. It is reported that the gold-bearing gravels have an average value of 35 cents per cubic yard.

The property is at present under option to L. M. Tobin, of Yuma, Arizona.

Picacho Basin Mine (Quartz). It is located 25 miles north of Yuma, and about 5 miles south of the Colorado River and the village of Picacho.

The property comprises 36 claims located in T. 13 and 14 S., R. 22 and 23 E., S. B. B. and M. Elevation 580 feet. Owner, Ridgeway Estate, of Philadelphia. Agent, F. F. Rielly, of Picacho. Under option to L. M. Tobin, of Yuma, Arizona.

The property was operated by the Picacho Basin Mining Company from 1904 to September, 1910, when operations were suspended. The production is reported to have been about \$2,000,000.

The rock formations are micaceous and hornblende schists, diorite and a few intrusive dikes, mostly granitic. On the east, south and west of the basin are rugged hills of rhyolite, rhyolite tuff and andesitic rocks, the most prominent mass being the rugged ridge called Picacho Peak. This peak has an elevation of 1500 feet above the Colorado River.

The orebody, which was a lode, occurred in lenses in schist, dipping at an angle of 45° to the southwest and the general strike of these lenses is N. 40° W. Three parallel and distinct lenses were developed on the property. The first lens developed was on the Pennsylvania claim. This shoot of ore was 250 feet long and 150 feet wide. It was first developed and worked through two shafts to a depth of 250 feet, then the ore was mined by the glory hole method. The glory hole is about 250 feet in length, with a width of 160 feet. The ore

from these workings was transported by rail to a mill on the Colorado River, a distance of five miles from the mine. In 1908, this mill was moved to the mine and installed at the Diablo shaft. It had a capacity of 400 tons. The Diablo shaft is located 750 feet southwest of the glory hole and the shaft is sunk on an incline of 50° to a depth of 450 feet. The lens of ore worked was 250 feet long and 160 feet wide. Levels were driven from the shaft every 50 feet. Most of the stoping on the shoot is northwest of the shaft. A large tonnage of ore was milled which is said to have had an average value of \$3 per ton. At the present writing the mill and buildings are being wrecked by Tobin and Brown of Yuma and the lumber is being hauled to Yuma for sale.

Bibl: State Mineralogist's Reports XII, pp. 237-243; XIII, pp. 331-346; XIV, pp. 729-730.

Potholes (Placer). These dry placers are located 10 miles northeast of Yuma and several miles west of Laguna Dam. Elevation 150 feet.



Picacho Basin Mine, showing Diablo shaft and dry placer workings.
Picacho, Imperial County.

The gold-bearing gravels of this region were extensively worked in the early days by Indians and Mexicans and the placers have produced considerable gold.

Bibl: State Mineralogist's Reports XII, p. 242; XIII, p. 344.

Senator Mine. This mine comprises one patented claim located in T. 15 S., R. 28 E., S. B. B. and M., five miles north of Potholes and about one-half mile from the Colorado River. Owners, W. W. H. Williams and O. B. DeWitt, of San Bernardino.

A quartz vein 8 feet wide occurs in the schist. It strikes northwest and dips 70° southwest. Development consists of an incline shaft sunk on the vein to a depth of 300 feet. Drifts have been run on the vein on the 100, 180 and 270-foot levels. A small amount of stoping was done on the 100 and 180-foot levels. Idle.

IRON.

A deposit of iron oxide, reported to carry 50 to 60 per cent iron, occurs about three miles northeast of Amos Station on the western slope of the Chocolate Mountains.

Dan Simpson of Niland, J. H. Churchill, and Edgar Wear of Los Angeles, have recently located a group of claims in Sec. 33, T. 9 S., R. 16 E., S. B. B. and M., on a deposit of magnetite that occurs in the Chocolate Mountains, 17 miles northeast of Niland.

LEAD AND SILVER.

Lead-silver ores occur in the county in the Paymaster district on the eastern slope of the Chocolate Mountains, 17 miles northeast of Glamis, a station on the Southern Pacific Railroad. Lead carbonate and galena also occur in the Picacho district, the principal deposit being located five miles east of Picacho, and one mile south of the Colorado River. The most productive mine was the Paymaster which was worked from 1867 to 1880. Since the latter date, spasmodic attempts have been made to work the property, and in recent years the tailings from previous mill operations were treated by the cyanide process.

Mines.

Homestake Mine comprises three claims located one mile northeast of Paymaster Mine, and two miles west of Midway Well, in the Poor-man's mining district. Elevation 750 feet. Owners, Vaughn Langlin and V. Bloomer, of Brawley.

The vein has a width of 6 feet, strikes N. 60° E., and dips 70° N. The formation is granitic gneiss and monzonite. The ore is lead carbonate and galena, carrying values in silver. Developments consist of a shaft sunk on the vein to a depth of 75 feet, a crosscut tunnel 25 feet in length and some shallow opencuts. Idle.

The Mayflower Mine comprises six claims located in Sec. 11, T. 14 S., R. 22 E., S. B. B. and M., five miles east of Picacho and one mile south of the Colorado River.

The ore is lead carbonate and galena which occurs in small veins and pockets in the schists. It is reported that some of the ore mined carried as high as 90 oz. silver per ton.

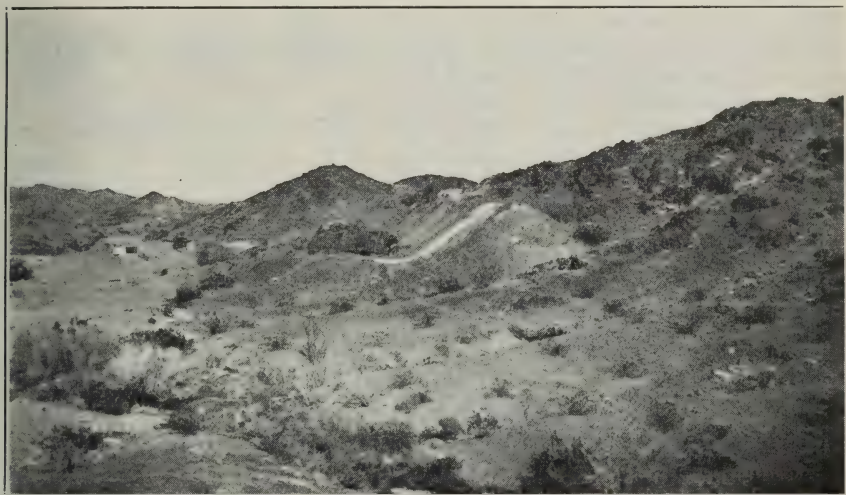
Developments consist of opencuts, short tunnel and shafts 50 to 90 feet in depth. Owner, W. H. Trenchard, of Laguna.

Paymaster Mine comprises thirteen claims located as the *Flagpole Group* but known as Paymaster Group of mines, situated in Secs. 19 and 30, T. 11 S., R. 20 E., and in Sec. 24 and 25, T. 11 S., R. 19 E., S. B. B. and M., on the eastern slope of the Chocolate Mountains, 25 miles by road northeast of Glamis, a station on the Southern Pacific Railroad, and three miles west of Midway Well. Elevation 800 feet. Owners, Judge Guy P. Hocker and J. C. Frank, 827 Stock Exchange Building, Los Angeles.

The mineralization occurs along a vein that is on the contact of granitic gneiss and monzonite which strikes N. 45° E., and dips 70° NW. A series of parallel rhyolitic porphyry dikes that strike south, intersect the Paymaster vein 500 feet east of the shaft. The vein

can be traced on the surface for a distance of over 4000 feet. The ore is lead carbonate, carrying silver values. Two ore shoots were developed by means of shafts. The Paymaster shaft was sunk to a depth of 385 feet on a 70° incline and ore stoped from 200-foot level to the surface for a distance of about 250 feet in length. Width of ore mined was from 8 to 15 feet. Two veins were worked on the Paymaster claim, known as footwall and hanging-wall veins. Levels were driven every 100 feet on the vein, with crosscuts run to footwall vein on each level. On the 300-foot level, northeast of the shaft, a winze has been sunk to a depth of 85 feet on the vein.

About 1500 feet to the east of the Paymaster workings is the President shaft and underground workings. This shaft was sunk to a depth of 425 feet on the footwall side of the vein and about in the middle of the ore shoot. The ore was stoped from about the 200-foot level to the surface, for a distance of 250 feet in length on the vein,



Paymaster Mine, showing view of Paymaster shaft. Chocolate Mountains, Imperial County,

the width stoped being from 15 to 35 feet between walls. Levels were driven from the shaft every 50 feet below the 200-foot level. Most of the stopes are east of the shaft, and only the hanging-wall section of the vein was worked on the 300 and 400-foot levels. The vein has a maximum width of 35 feet and shows streaks of galena in the drifts on these levels. From a study made of the stopes, it appears that the orebody worked from the surface ended at the 150-foot level; then another lens of ore was worked from the 200-foot level to probably the 350-foot level. It is reported that the ore milled from the President workings carried 20 oz. in silver and from 7% to 10% lead.

About 1800 feet east of the President workings are the Hazel workings. Here two shafts have been sunk on the vein to depths of 50 and 100 feet. The vein exposed in these workings is 15 feet wide. The ore is lead carbonate and galena, carrying small values in silver. It is said that samples taken from drifts on the vein carried 6 oz. silver and 10% lead.

The owners of the property also own 40 acres of patented land located in Sec. 15, T. 11 S., R. 20 E., on which is located a well and pumping plant with a 2-inch pipe line $3\frac{1}{2}$ miles in length running from the well to the mine. The pumping equipment consists of gas engine, Gould Triplex pump and storage tank.

The Paymaster Mine was first located in 1867 and about 1870 a 10-stamp mill was installed on the property and operated until 1875. This mill probably treated 30,000 to 40,000 tons of ore from the Paymaster and President workings. It is reported that at one time there were about 20,000 tons of tailings on the property but a good proportion was washed away by cloudbursts and there are now about 6000 to 8000 tons, reported to assay 6 to 8 oz. in silver.

From 1880 to 1916 this property was located by a number of different parties but no production was made during this period. In 1916 the property was acquired by the Anaheim Exploration and Development Company; C. E. Holcomb, of Anaheim, California, president. This company installed a concentration plant at Midway Well and attempted to treat the ore from the Hazel workings. In 1918 the property was acquired by Judge Guy P. Hoeker and J. C. Frank, of Los Angeles, who are the present owners.

In 1923 a cyanide plant was installed and 8000 tons of tailings, said to assay 6 to 8 oz. in silver, were treated, recovering \$50,000 in silver. Idle.

MANGANESE.

Commercial deposits of manganese ore occur in the Paymaster district, in an outlying spur from the southeastern part of the Chocolate Mountains and in the Palo Verde district, in the Palo Verde range of mountains.

The Palo Verde Mountains are a mass of deeply-eroded volcanic flows extending from the vicinity of the Colorado River, eight miles south of Palo Verde, northwestward for about 20 miles. The manganese deposits occur in a number of short veins or shear zones that cut the basic lava flows.

In the Chocolate Mountains the veins containing the manganese deposits cut lavas of Tertiary age, and a conglomerate that is probably Quaternary.

The manganese ore consists of the oxides, psilomelane, pyrolusite and manganite. Psilomelane is the dominant oxide in all these deposits.

The deposits in the Chocolate Mountains are accessible from Glamis, on the Southern Pacific Railroad, by wagon road 32 miles long, and the Palo Verde deposits are about 37 miles by road from Glamis.

Manganese ore was mined and shipped from the deposits in the Chocolate Mountains in 1917 and 1918 and from the Palo Verde District early in 1917. Operations were suspended in the latter part of 1918 on account of the resumption of imports of high-grade foreign ores.

The Ebony Group, formerly known as the Ebony group of claims, is located in the northwestern section of the Palo Verde Mountains, six miles south of Wiley Well, and about 40 miles by road northeast of Glamis, a station on the Southern Pacific Railroad. The elevation is 1100 feet.

A number of narrow veins containing manganese and having a general northerly strike, occur in the basic lava. These veins are from a few inches to several feet in width. Psilomelane is the principal manganese oxide but it is more or less mixed with iron oxides and calcite. A number of shallow open-cuts have been made on the different vein outcrops, exposing 6 to 12 inches of manganese ore. No ore has been shipped from the property.

Bibl: State Mining Bureau Bull. 76, pp. 34-35.

Everharty or Tres Amigos Deposit is located in the Chocolate Mountains, 32 miles by road northwest of Glamis, a station on the Southern Pacific Railroad, in T. 11 S., R. 21 E., S. B. B. and M., in the Paymaster district. The elevation is 1200 feet.

The deposit was worked in 1917 by J. J. Everharty, who shipped a considerable quantity of high-grade ore. In 1918 the property was leased to the Tres Amigos Company, of Los Angeles, and a small amount of ore was shipped. It was then subleased to Suffern & Company, of New York, who operated the property until August, 1918, when it was relinquished to J. J. Everharty. It is reported that the greater part of the ore contained more than 40 per cent of manganese and less than 8 per cent of silica. The ore was hauled by motor truck to Glamis and then shipped to furnaces in Pennsylvania and Illinois.

The deposits of manganese ore are contained in fissure veins that cut both the sedimentary and igneous rocks. The veins strike from N. 10° W. to N. 50° E. The majority of the veins strike N. 25° E. and dip from 65° to vertical. These veins vary in width from one to four feet.

On what was formerly known as the Black Mountain Claim, a vein which strikes N. 10° W. and dips 80° E. has been exposed for a distance of 150 feet by two tunnels. A considerable tonnage of ore was mined from the upper tunnel. The vein can be traced southward from this tunnel for a distance of 1300 feet to another tunnel. Between these two tunnels are croppings of ore from one to four feet wide. The vein worked in the south tunnel was two feet wide.

A shear zone 10 feet wide which cuts volcanic breccia occurs on the southwest side of the arroyo. This zone contains numerous veinlets and seams of psilomelane for 100 feet along its strike. A tunnel 40 feet long has been run in this shear zone. A quarter of a mile south is a fissure vein which cuts an andesite breccia. This vein strikes N. 50° E. and dips 75° SE. The vein has been developed on the surface by an open-cut about 150 feet long, and by a tunnel 50 feet long. In the open-cut the vein exposed is three feet in width. The ore on the surface is hard and is mostly psilomelane but in depth the ore becomes softer and manganite and pyrolusite become more abundant.

Bibl: U. S. Geol. Surv. Bull. 710-E.

Palo Verde Deposits of manganese are located in the Palo Verde Mountains about five miles west of the wagon road between Palo Verde and Glamis, in T. 9 and 10 S., R. 19 E., S. B. B. and M. Elevation is 1000 feet.

Several claims were held on this deposit by T. Lugo, of Palo Verde. The deposit was worked in the early part of 1918 and a small quantity of ore shipped.

The manganese deposits are in a number of short veins or shear zones that cut basic lava flows. The veins strike N. 65° E. and are vertical. The vein material is from a few inches to several feet wide, and consists of fragments of basalt cemented together with manganese oxides and cut by veinlets of calcite. The veins have been developed by short tunnels and open-cuts. The ore shoots are short, being only a few feet in length. Psilomelane is the principal manganese oxide but it is more or less mixed with iron oxides and calcite.

Bibl: State Mineralogist's Report XVII, p. 269; U. S. Geol. Surv. Bull. 710-E.

Tolbard Manganese Deposit (Imperial Manganese Mines) is located on the southeast slope of a spur of the Chocolate Mountains, in T. 11 S., R. 21 E., S. B. B. and M., 30 miles northeast of Glamis by wagon road and 8 miles southeast of Midway Well. Elevation is 800 feet.

In 1917 O. S. Tolbard located three claims known as the Black Sheep No. 1, No. 2 and No. 3, on the hill east of the arroyo and on the southeast side of the north end of the Tres Amigos claims. Operations were begun by the Tolbard Mining Company in June, 1917, and considerable ore was produced from the property until the latter part of 1918 when operations were suspended. It is reported that ore shipped contained 46% manganese, 0.5% iron, and 2.5% silica. This property and the Tres Amigos group were relocated in 1925 by Page Bros., of Glamis, and it is reported that the Pacific Coast Steel Company, of Los Angeles, has purchased the claims.

The principal development work is on what was known as the Black Sheep claim. It consists of four tunnels and a shaft near the portal of one tunnel. Work on the other two claims consists of shallow open-cuts. The total amount of work amounts to about 600 feet.

The deposits of manganese ore are contained in fissure veins that cut both sedimentary and igneous rocks. Three veins have been worked on the Black Sheep claim. These veins can be traced for over 1000 feet but the ore has been mined from them in two shoots only, the longer being 400 feet. Other veins occur on these claims but they have not been explored to any extent. The veins vary in strike from N. 25° E. to N. 40° E., and dip from 65° to vertical, and vary in width from a few inches to four feet. The manganese oxides are mostly psilomelane, though with increasing depth the softer oxides, manganite and pyrolusite become more abundant. The cost of mining is said to have been from \$6 to \$10 per ton. Haulage from the mine to Glamis, a distance of 32 miles, costs \$15 per ton.

Bibl: U. S. Geol. Surv. Bull. 710-E.

NICKEL.

Nickel occurs on the south slope of the Coyote Mountains. The extent of the deposit has not been determined as very little prospecting has been done on the surface outcrop. The ore is chiefly garnierite, a nickel-magnesium silicate.

SILVER.

Silver is found in the southeastern part of the county associated principally with copper, gold and lead ores. In the Paymaster district on the True Friend and Silver Moon claims it occurs in the form of argentite. The principal production of silver has been from the Paymaster Mine, where it occurs with galena and lead carbonate ores.

True Friend and Silver Moon Group of Mines. These claims are located three miles southeast of the Midway Well, which is on the Blythe-Glamis road, and about 20 miles northeast of Glamis, in an eastern spur of the Chocolate Range of Mountains, in the Paymaster district. These claims were located in 1914, and worked during 1915 and 1916. Frank Beal, of Brawley, is the owner.

The principal workings are on the True Friend claim, and are located on the northeast slope of the highest peak of the range. A vein of spar, principally barite stained with iron and manganese oxides, occurs on the contact of granitic gneiss and porphyry. It strikes N. 20° E., and dips 80° NW. This vein has a width of 15 to 20 feet. A tunnel has been driven S. 50° W., 150 feet; and 70 feet from the portal a crosscut has been driven west 50 feet. About 200 feet south of these workings, over the top of the ridge, is a shaft 50 feet deep. Ore occurs in lenses in the spar vein. It is reported that the ore mined assayed from \$20 to \$40 per ton in silver. Only assessment work is being done on the property. Idle.

ZINC.

Southern Star Group comprises four claims located four miles southwest of Coyote Wells in Sec. 30 and 36, T. 17 S., R. 8 and 9 E., S. B. B. and M., near the border of Mexico. Elevation is 175 feet. Owner, C. E. Weaver, of 105 E. First Street, Los Angeles.

In this area the formation is limestone overlain by about 200 feet of gravel wash. A six-inch stringer, mineralized with sphalerite, occurs in the gravel detritus. The ore extracted from this stringer is reported to assay from 20 to 60% zinc.

Development consists of a shaft and open-cuts made along the outcrop of the vein. The owner reports that a small tonnage of high grade zinc ore is on the dump. Two men are employed on development.

NON-METALLIC MINERALS.

The rapid growth of the cities of Imperial Valley and especially the city of San Diego, has increased the demand for both industrial and structural materials. Imperial Valley has a variety of commercial minerals, and a large tonnage of industrial materials are shipped north to the manufacturing centers along the Pacific Coast. Deposits of gypsum, marble and limestone occur in the western end of the county and within easy access to railroad transportation. Since the Fourteenth Report of the State Mineralogist was published, the extensive deposits of gypsum located in the Fish Mountains near the western border of the county, have been opened up by the Pacific Portland Cement Company and a 300-ton plant for the manufacture of plaster and other products built at Plaster City, on the San Diego and Arizona Railroad.

With the rapid growth of the towns of Imperial Valley, and the large amount of road construction, has come an increased demand for crushed rock products and several plants are under operation. The most important recent development has been the exploitation of the cyanite deposits near Ogilby, by the Vitrifax Company, of Los Angeles.

The principal non-metallic minerals occurring in the county are: clay, cyanite, gypsum, limestone, marble, pumice, soda, sulphur, strontium, but with the exception of cyanite, pumice and gypsum, these deposits are largely undeveloped.

CLAY.

Imperial County contains extensive deposits of river silt that has been used for the manufacture of common brick and tile.

Extensive exposures of Tertiary clays are found on the west margin of Imperial Valley toward Carrizo Creek. These clays are many miles in extent and of great thickness, but have not been prospected sufficiently to determine their value for commercial purposes. On these Tertiary clay deposits, a number of locations have been made by the Columbia Cement Company, of Los Angeles, and the American Portland Cement Company, of San Diego.

BRICK.

During the development of the towns of Imperial Valley, a number of local brickyards have been established and operated for a short time. *The Simons Brick Company*, of Los Angeles, is the only manufacturer of brick and tile in the valley at present writing and this company only operates the plant at intervals to supply the local demand. Simons Brick Company, main office, 125 West Third Street, Los Angeles, Walter R. Simons, president. The brick plant is located about one mile southeast of El Centro.

The clay used is local silt of the valley which is very fine and sticky. This deposit continues unchanged to a depth of 1500 feet as shown by local borings but varies slightly in texture and the proportion of sand present, the variations in composition occurring every 3 to 4 feet. This variation enables the brick maker to mingle layers of different qualities and form a brick mixture of suitable character.

The material from the clay pit is delivered by scrapers to the hopper, from which it goes to a belt conveyor, and is elevated to a set of rolls. The material from rolls is elevated by bucket elevator to a screen. The through size from the screen goes to two stiff-mud brick machines. The brick and tile go to drying sheds, then are oil fired in open field kilns. The plant is operated according to local demand only, and was idle at the time of visit.

Full Moon Clay Deposit. The deposit is located on the southwestern slope of the Chocolate Range of mountains, in T. 10 S., R. 16 E., S. B. B. and M., 8 miles north of Iris siding on the Southern Pacific Railroad.

Holdings comprise five claims known as the Full Moon group. Owner, J. Thebo, of La Mesa, California.

The clay is a white talcose clay, showing a high aluminum content. The development consists of a number of open cuts along the surface outcrop. Analysis of clay made by A. J. Forget, of Los Angeles:

Silica (SiO_2)	27.93%
Alumina (Al_2O_3)	42.33%
Iron (Fe_2O_3)	1.92%
Lime (CaO)	0.53%
Soda	0.70%
Water (combined)	12.44%
Moisture	0.74%
Sulphur Anhydride (SO_3)	13.39%
	100.00%

CYANITE AND DUMORTIERITE.

Cyanite (Al_2SiO_5 and dumortierite ($8\text{Al}_2\text{O}_3 \cdot \text{B}_2\text{O}_3 \cdot 6\text{SiO}_2 \cdot \text{H}_2\text{O}$) are both aluminum silicates but with slightly different physical characteristics.

Cyanite is an aluminum silicate of the same chemical composition as andalusite and sillimanite, but crystallizing in the triclinic system; occurs usually in long-bladed crystals rarely terminated; hardness 5-7.25; gravity 3.56-3.67; color, blue.

An extensive deposit of cyanite occurs near Ogilby which is being developed by the Vitrifax Company, of Los Angeles.

Dumortierite is a basic silicate of aluminum, with boron, but crystallizing in the orthorhombic system. It occurs usually in small prisms; color, blue, dark blue and violet-red; hardness 7, gravity 3.22-3.43.

Dark blue boulders of dumortierite have been found in the washes in the Picacho district about 25 miles from Ogilby. These metamorphic minerals are found in the schists and gneisses.

Ogilby Cyanite Deposits. The deposits of cyanite occur near the base of hills on the western slope of the Cargo Muchacho range of mountains, three miles northeast of Ogilby. Elevation 500 feet. Holdings comprise ten claims known as the Drifted Snow and Blue Bird groups. 200 acres. Owner, Vitrifax Company, 5100 Pacific Boulevard, Los Angeles.

The first discovery of cyanite was made in a low, rounded hill one-eighth mile wide by one-half mile long, and probably consists of 25 per cent cyanite in a matrix of quartz. One-quarter of a mile farther east,

a prominent vein of cyanite outcrops for one-half mile in length, at the foot of the Cargo Muchacho range. The vein, which occurs in a mica schist, is nearly vertical and varies from 10 to 200 feet in width. Open-cuts and tunnels have been made along the deposit for a distance of over 500 feet along the strike. The most extensive showing has been found on the north end of the deposit. Here it outcrops for over 200 feet in width. Quartz is the gangue mineral while small amounts of black tourmaline occur throughout the vein material. On the south end of the deposit, both walls of the vein have a selvage of talc.

Eight to ten men are employed in getting out material for shipment to the company's plant at Los Angeles where experiments are being carried on to remove the quartz gangue or free silica, to make it suitable for manufacture of high-grade porcelain ware.



Vitrifax Cyanite Deposit, Cargo Muchacho Range, near Ogilby, Imperial County.

GEMS.

The gem, turquoise, occurs on the eastern slope of the Chocolate Mountains on some claims owned by Chas. Allen and Frank Beal, of Brawley. These claims are located about two miles east of the Midway Well, on the trail to the True Friend and Silver Moon mines.

The turquoise is bluish-green in color and it occurs in pockets and nodules in a porphyritic rock. There has not been enough development on the deposit to determine the extent or the value of the turquoise for gem material.

GYPSUM.

In Imperial County there is a large deposit of gypsum on the north side of Fish Mountain and another extensive deposit on the south side of Carrizo Mountain. The deposit on the northwestern edge of the Fish Mountains occurs mainly in an immense deposit three miles in length from the southeast to the northwest, with an area of about 1000 acres.

The Fish mountains lie chiefly in T. 13 and 14 S., R. 9 and 10 E. The gypsum outcrops are in Secs. 19, 20, 29, 30, 32 and 33, T. 13 S., R 9 E., S. B. B. and M.

Since Report XIV of the State Mineralogist was published, the deposit was acquired in 1920 by the Imperial Gypsum and Oil Company, of Los Angeles, who developed the deposit and installed a narrow gauge railroad, 26 miles in length, from the mine to a point 3 miles north of Dixieland, on the San Diego and Arizona Railroad. At this junction of the two railroads, a small crushing plant was installed for the purpose of shipping the crushed rock to Los Angeles for the manufacture of stucco plaster.

In the latter part of 1924, the deposit and holdings of the Imperial Gypsum and Oil Company were purchased by the Pacific Portland Cement Company, Consolidated, of San Francisco. This company built a plaster manufacturing plant having a capacity of 300 tons per day, and a town for the employees, now known as Plaster City.

Carrizo Gypsum Deposit. A large deposit of gypsum occurs on the south side of Carrizo Mountain, 7 miles north of Carrizo Springs and 20 miles northwest of Coyote Wells, in T. 13 and 14 S., R 9 E., S. B. B. and M. Owners, Carl F. Schroder and Amon Moore, of Los Angeles.

The quality and extent of the deposit is very similar to that of the deposit to the northeast.

Coyote Mountain Gypsum Deposit. This deposit occurs on the south slope of the Coyote Mountain range, 3 miles northwest of Coyote Wells. Owners, M. A. Turner and associates, of San Diego.

The gypsum is exposed over an area of about 10 acres, has an average depth of 8 feet, and it is estimated that the deposit contains about 80,000 tons, with a continuation under the outcrop that cannot be determined. The quality of the gypsum is said to be the same as the Fish Mountain deposits.

Pacific Portland Cement Company, Consolidated. Robert T. Henderson, president; H. T. Battelle, secretary; J. H. Colton, general manager; C. F. Stahl, superintendent. Offices, 821 Pacific Building, San Francisco.

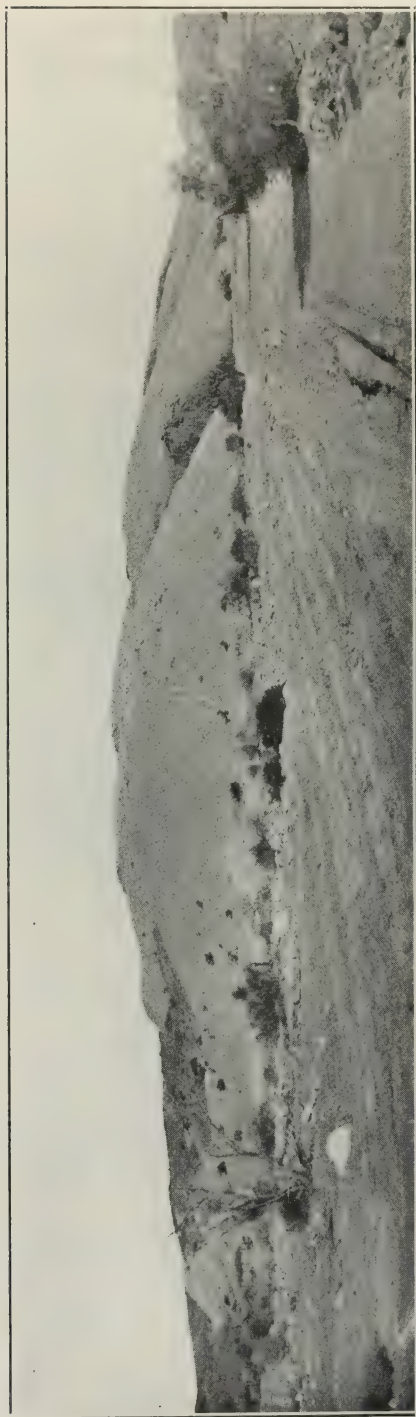
The plant is located at Plaster City, on the San Diego and Arizona Railroad, 16 miles west of El Centro. The holdings of the company comprise 1200 acres in the Fish Mountains, in Secs. 19, 20, 29, 30, 32 and 33, T. 13 S., R. 9 E., S. B. B. and M., 26 miles northeast of Plaster City.

The gypsum occurs as an immense deposit about three miles in length from southeast to northwest, and about three-quarters to one mile in width, with an average thickness of over 150 feet. The beds dip 15 to 25 degrees west. It is stated that the gypsum mined has the most uniform grade of any deposit in the United States, the average being 95% gypsum. The deposit may be said to contain an inexhaustible supply of commercial gypsum.

Analysis of the gypsum made by J. Wilkes Jones, chemist:

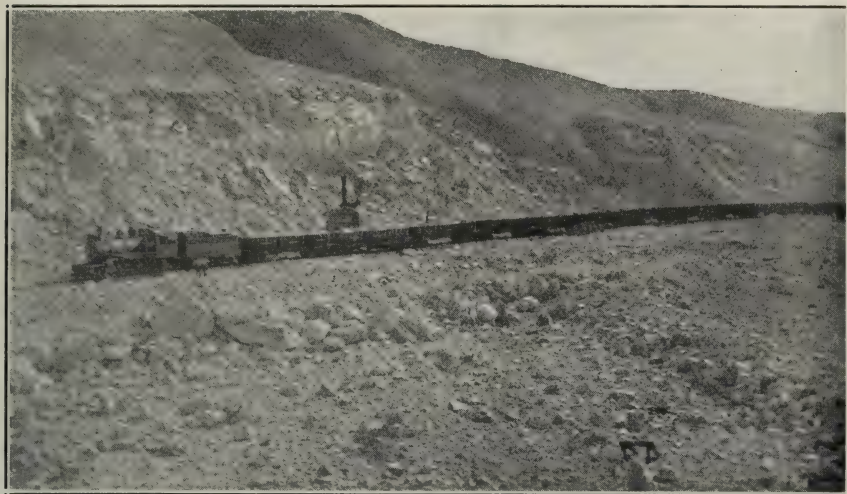
Sulphuric Anhydride (SO_3)	47.17%
Lime (CaO)	32.75%
Crystallized Water	18.75%
Silica (SiO_2)	.92%
Iron Oxide (Fe_2O_3)	.14%
Alumina (Al_2O_3)	.21%
Magnesia (MgO)	.08%

100.02%

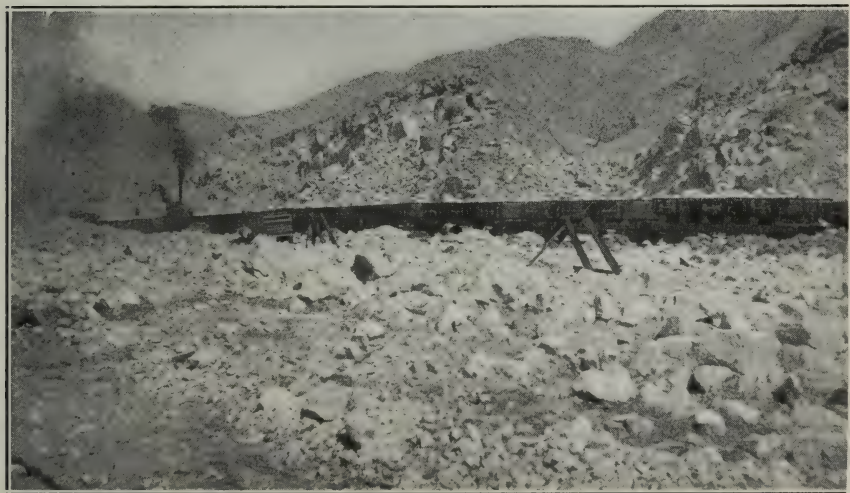


Gypsum Deposit of Pacific Portland Cement Company, Consolidated. Fish Mountains, Imperial County.

The gypsum values, calculated to $\text{CaSO}_4, 2\text{H}_2\text{O}$, average better than 95% as shown by many of the company's analyses, and also by the report rendered by the Chemistry Division of the California Department of Agriculture. The quarry has been opened up for a distance of 2000 feet in length in a northwest direction, with an average height



Pacific Portland Cement Company's gypsum quarry showing steam shovel loading company's train of cars. Fish Mountains, Imperial County.

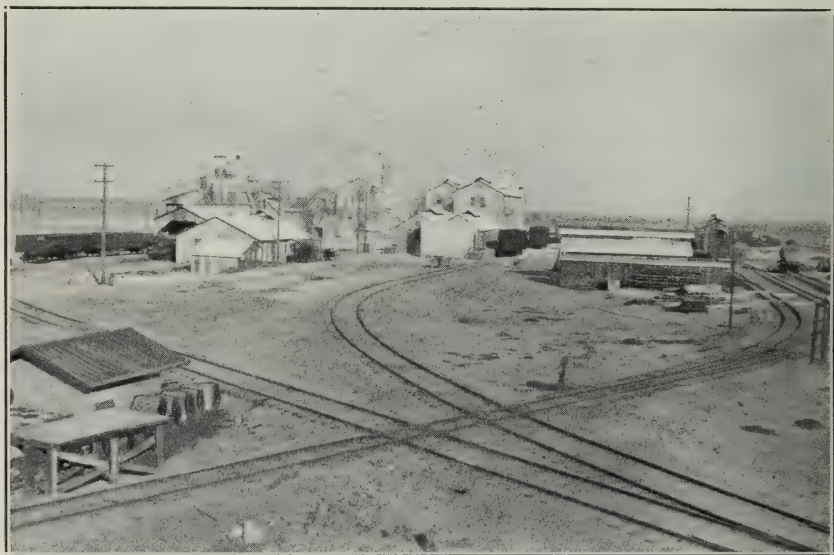


Gypsum Deposit of Pacific Portland Cement Company. Fish Mountains, Imperial County.

above the floor of the quarry of over 50 feet. The rock gypsum is first drilled with an Armstrong churn drill, and then a series of holes are blasted, breaking down a large tonnage. The broken material is loaded by a Marion steam shovel into 30-ton steel side-dump cars, then hauled in a train of 10 to 18 cars by locomotive to the plant at Plaster City.

The equipment at the quarry consists of blacksmith and machine shops, buildings for employees, 260-cu. ft. Ingersoll Rand compressor, driven by 25-h. p., Fairbanks-Morse gas engine, Marion steam shovel, and one Armstrong churn drill.

Plant: The capacity of the gypsum plant at Plaster City is 300 tons per day. Rock from the quarry is dumped from cars into a 30" x 44" Ehrsam jaw crusher. The product from this crusher then goes to two 42-inch Ehrsam rotary crushers, producing 1½" to 2" product which is elevated to screens and screened to one-inch size, making a product suitable for cement retarder that is used in the manufacture of Portland cement. The over-size material from the screens goes to two Raymond roller mills, where it is ground to pass 200-mesh. Each Raymond mill is equipped with a set of Raymond exhausters for collection of the fine dust. The fine dust goes to storage bins, and is sold for agricultural gypsum. Following the grinding stage, the gypsum is ready to be made



300-ton Plaster Mill. Pacific Portland Cement Company. Plaster City, Imperial County.

into various kinds of plaster. The process consists of removing the moisture from the raw product, which is made up of 20% water and 80% calcium sulphate. The material is calcined in three large kettles, each having a capacity of 10 tons of plaster. The powdered gypsum is mechanically fed from storage bins into the kettles, which are fired with oil burners underneath. The temperature of the kettles is about 212° Fahrenheit, when the powdered gypsum is injected. The heat is gradually increased until the water of crystallization in the gypsum is carried off as steam. The steam in rising floats the gypsum powder and gives it the appearance of boiling. This stage is reached at 340° Fahrenheit. A gear driven vertical shaft at the bottom of which is attached paddles, continually stirs the material in the kettles during the heating process. On the completion of the heating operation, the hot powder is run off into cooling bins, before mixing. The mixing

operation consists of running into the powdered gypsum desired amounts of retarder and binder, the latter usually being hemp.

The binder is only used in the manufacture of hard wall building plaster. The gypsum, retarder and binder are carefully weighed and mixed according to formulas supplied by the chemist in the laboratory of the plant. From the mixing bins, the material goes by gravity to three Bates automatic baggers, where the plaster is sacked for shipment. From the sacking room, the product is loaded into railroad cars.

In addition to manufacturing fertilizer, cement retarder, hard wall and finished building plasters, casting, moulding and dental plasters, the company manufactures Empire gypsum tile blocks for buildings.

Electric power is secured from the Southern Sierras Power Company. Water for operation of the plant is secured from Dixieland, while water for drinking purposes is secured from Coyote wells. Eighty men are employed at the plant.

The following is a list of the owners of other undeveloped deposits of gypsum located in the Fish Mountains:

F. L. Blanc owns 640 acres located in Sec. 30 and 31, T. 13 S., R. 9 E., and in Sec. 6, T. 14 S., R. 9 E., S. B. B. and M., located west of the Pacific Portland Cement Company's deposit.

Bert R. Chaplin, Suisun, owns 120 acres in $SE\frac{1}{4}$ of $SW\frac{1}{4}$, $S\frac{1}{2}$ of $SE\frac{1}{4}$, Sec. 19, T. 13 S., R. 9 E., S. B. B. and M.

Both the Blanc and Chaplin deposits are under option to the Pacific Portland Cement Company.

W. F. Gillett, of Holtville, owns a deposit, comprising 40 acres located in $N\frac{1}{2}$ of $NE\frac{1}{4}$ of $NW\frac{1}{4}$; $N\frac{1}{2}$ of $NW\frac{1}{4}$ of $NW\frac{1}{4}$ of Sec. 33, T. 13 S., R. 9 E., S. B. B. and M.

Ed H. Houck, of Imperial, owns 40 acres located in the $SW\frac{1}{4}$ of $NW\frac{1}{4}$ of Sec. 28, T. 13 S., R. 9 E., S. B. B. and M.

W. H. Waters, of Dixieland, owns a deposit of gypsum adjoining the holdings of the Pacific Portland Cement on the south and located in the $NW\frac{1}{4}$ of Sec. 4 and $E\frac{1}{2}$ of Sec. 5, T. 14 S., R. 9 E., S. B. B. and M., comprising 320 acres.

The gypsum is exposed in a cut to a depth of 60 feet and analysis shows that it will average 95 per cent gypsum.

LIMESTONE AND MARBLE.

The chief deposits of this material in Imperial County are in the Coyote Mountains, T. 15 S., R. 10 E., and the Fish Mountains in Sec. 1, 7 and 12, T. 14 S., R. 9 E., S. B. B. and M.

These deposits of crystalline limestone are extensive, and due to the fact that this limestone has a low magnesia content makes it ideal for cement manufacture.

The raw materials for Portland cement are very abundant on the west side of the Imperial Valley, in great deposits of Tertiary clay and crystalline limestone which are close together and close to railroad transportation.

The chief deposits of marble are in the Coyote Mountains, T. 15 S., R. 10 E., S. B. B. and M. This mountain is largely formed of crystalline limestone but not all of it is fit for marble. Here valuable deposits within 6 miles of the San Diego and Arizona Railroad are owned and controlled by the Columbia Cement Company, of Los Angeles. This

company has opened up a number of deposits, each deposit being of different grade and color. Several have the grade and texture of famous imported marbles.

Columbia Cement Company. Fred A. Ballin, president, Arthur Languth, secretary. Offices: National City Bank Building, Los Angeles.

This company controls 8000 acres of limestone, marble and clay deposits, situated in the Coyote Mountains, in T. 15 S. and 16 S., R. 9 and 10 E., S. B. B and M., $6\frac{1}{2}$ miles northwest of Coyote Wells, on the main line of the San Diego and Arizona Railroad. Elevation 800 to 2300 feet.

Since the publication of Report XVII of the State Mineralogist, the Columbia Cement Company has acquired control of the holdings of the Southern California Marble Company, Golden State Mining and Marble Company, the Schrader and Moore and other minor holdings in this area.

The deposits consist of limestone, marble and micaceous schist resting on andesite lava, at an elevation of 800 feet. Coyote Peak has an elevation of 2335 feet. The beds of blue-gray limestone, which are steeply tilted, dipping 70 degrees to the northeast, strike northwest. These beds of limestone are interstratified with beds of micaceous schist. This belt of limestone extends for three miles in length and has a width of about two miles. The major portion of the limestone is in Sec. 22, 26 and 35, T. 15 S., R. 9 E., and in Sec. 2, T. 16 S., R. 9 E. It is estimated that the available tonnage of commercial limestone is about 600,000,000 tons.

MARBLE.

The Creole Group consists of four claims covering an outcrop of marble about 4500 feet long and averaging 600 feet in width, located in the NE $\frac{1}{4}$ of Sec. 36, T. 15 S., R. 9 E., S. B. B. and M. Here are three distinct strata of marble. The marble has a hardness of 3.5 and the colors range from blue-black, gray, white, mottled black and white, and blue. The deposit is estimated to contain 3,000,000 cubic feet of commercial marble.

Two quarries were opened up on this deposit by the Golden State Mining and Marble Company, of San Diego, the former owners. Equipment on the property consists of one derrick.








One mile south of this deposit, in Sec. 1, T. 16 S., R. 9 E., and in Sec. 35, T. 15 S., R. 9 E. are deposits of marbleized limestone that occur along a belt of limestone that strikes N. 30° W., and has a general dip of 70° E. Here the outcrops reach a height of 150 to 200 feet above the base of the exposure, and are from 100 to 200 feet in thickness, and between 500 and 1200 feet in length. A number of quarries were opened along this belt of limestone by the former owners, known as the Southern California Marble and Development Company, of San Diego. The marble that has been quarried is of fine texture, hard and takes an excellent polish, as shown by samples taken from the property. As a commercial marble it is said to rank with Georgia white and the English vein marble. These deposits are estimated to contain 200,000,000 cubic feet of commercial marble. In low hills east of the main range, the company owns a deposit of Tertiary clay, averaging 70 feet in thickness and covering more than 300 acres.

MAP
OF
LIME STONE DEPOSITS
COLUMBIA CEMENT COMPANY
IN THE
COYOTE MOUNTAINS
IMPERIAL COUNTY
CALIFORNIA

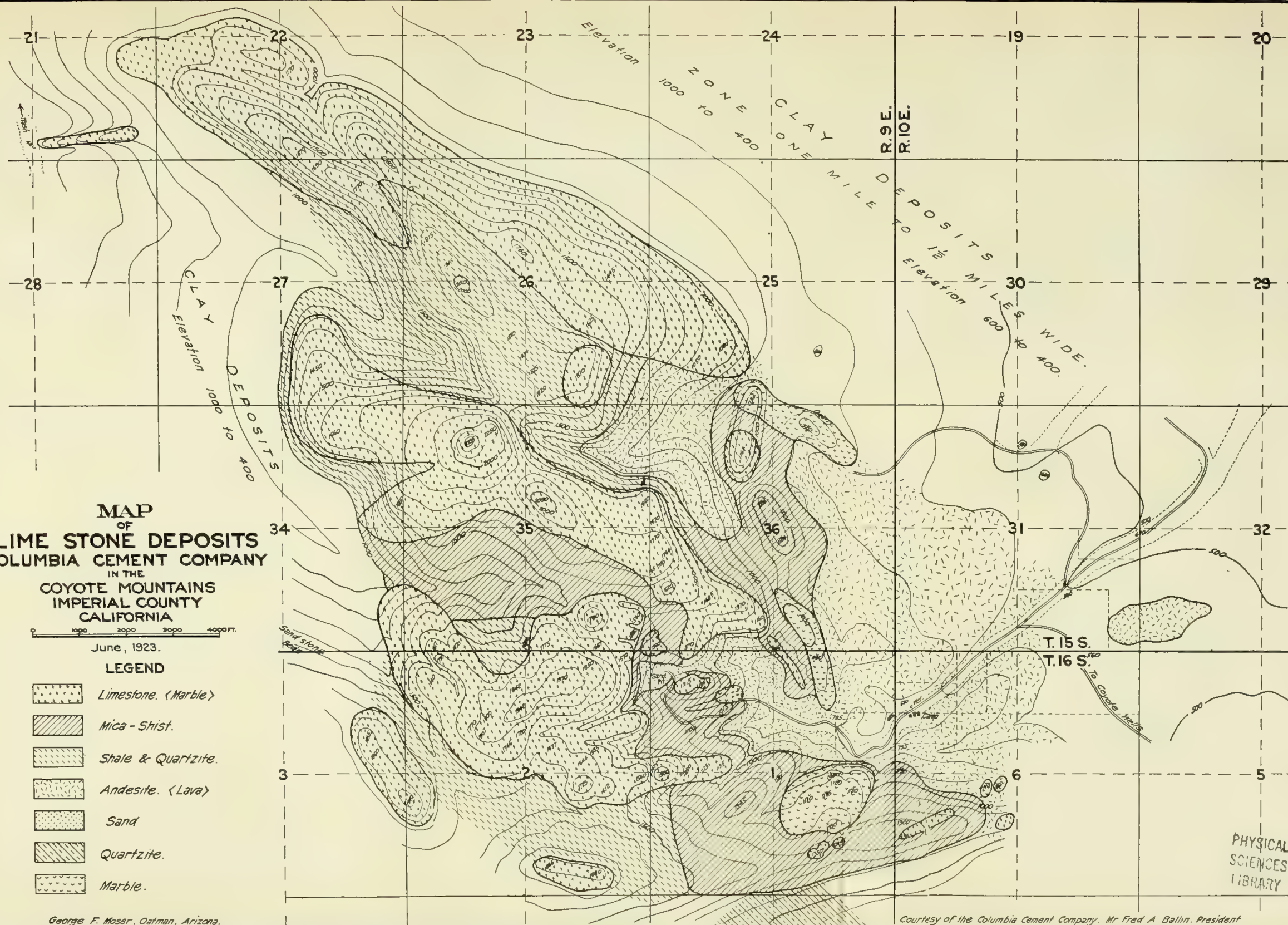
0 1000 2000 3000 4000 FT.

June, 1923.

LEGEND

-  Limestone. (Marble)
-  Mica - Shist.
-  Shale & Quartzite.
-  Andesite. (Lava)
-  Sand
-  Quartzite.
-  Marble.

George F. Moser, Oatman, Arizona.



Courtesy of the Columbia Cement Company. Mr. Fred A. Ballin, President

Analysis of limestone made by Smith Emery Company, of Los Angeles, is as follows:

Mark	White	Blue
Silica (SiO_2)	1.00%	1.08%
Iron Oxide (Fe_2O_3)	0.05%	0.02%
Aluminum Oxide (Al_2O_3)	0.76%	Trace
Calcium Oxide (CaO)	54.32%	54.00%
Magnesium Oxide (MgO)	1.78%	1.48%
Loss on Ignition	42.05%	43.40%
	100.00%	99.98%

The carbonate of lime equivalent is 96.92% (CaCO_3).

The great deposits of Tertiary clay and crystalline limestone owned by the Columbia Cement Company form the basis for a large cement plant.

Bibl: State Mineralogist's Report XV, pp. 733-736; XVII, p. 238. Bull. 38, p. 107.

Mountain Springs Limestone Deposit. This deposit is located on the main highway from Jacumbo to El Centro, and is two miles east of Mountain Springs and 8 miles west of Coyote Wells.

Holdings comprise two claims owned by Dan Ruby, of Boulevard, California.

The belt of limestone strikes N. 30° E., and dips 60° SW. The beds of limestone are interstratified with schist. The beds have a thickness of 200 feet. The deposit was formerly operated by the Duralite Products Company, of San Diego.

Waters' Limestone Deposit. It comprises a group of claims located in Sec. 1, 7 and 12, T. 14 S., R 9 E., S. B. B. and M., 14 miles north of Coyote Wells, in the Fish Mountains. Holdings comprise 1200 acres owned by W. A. Waters, of Dixieland.

This is an immense deposit of crystalline limestone on the crest of the Fish Mountains, the major portion of the limestone being in Sec. 1 and 12, T. 14 S., R. 9 E., at elevations ranging from 1000 to 1600 feet. The belt of blue-gray limestone strikes N. 30° W. and dips 65° E. It is three miles long by one mile wide, and is exposed for a depth of 600 feet. Analysis of the limestone shows 97 to 98% CaCO_3 with only 0.7% MgCO_3 .

In Sec. 31 and 32, T. 13 S., R 9 E., is another deposit of limestone that occurs on the east slope of the Fish Mountains. A tract of 160 acres is owned by W. A. Waters, of Dixieland. The quality of the limestone is not as good as the above mentioned deposit.

Analysis of limestone by John T. Rice, of El Centro, is as follows:

Sample Sec. 1 and 12		Sample Dixieland Claim
Calcium Carbonate (CaCO_3)	98.02%	90.02%
Magnesium Carbonate (MgCO_3)	.77%	.39%
Iron and Aluminum Oxides (Fe_2O_3 & Al_2O_3)	.83%	.72%
Insolubles	.34%	6.43%

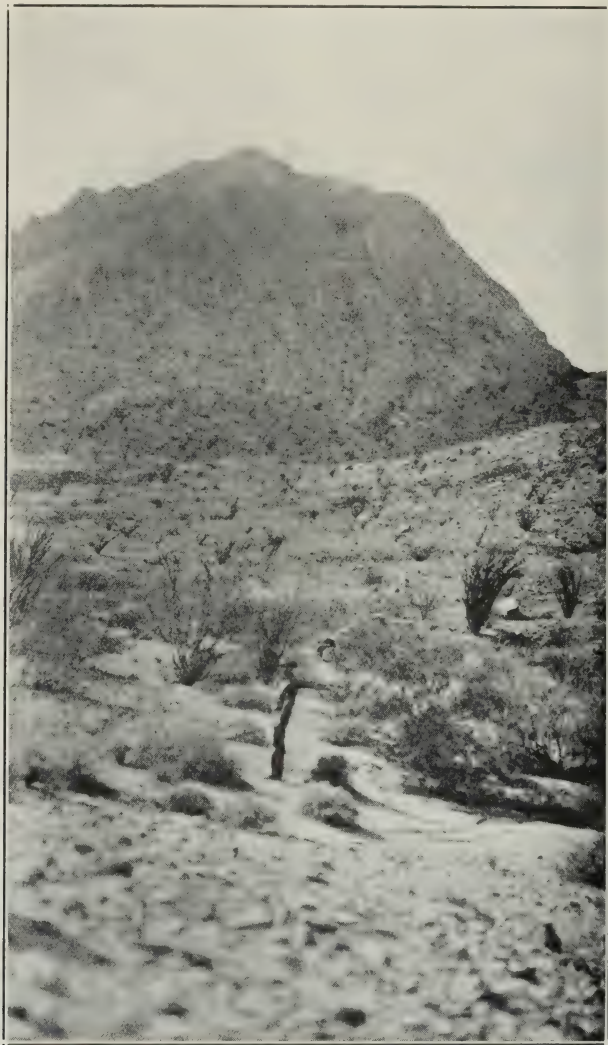
MINERAL PAINT.

Mullet Island Paint Deposit. A number of thermal springs occur on the north end of Mullet Island at the southeast end of the Salton Sea.

These springs deposit iron oxide about their vents in the form of yellow and red ocher. Capt. Chas. Davis, Niland, owner.

MINERAL SPRINGS.

Soda Springs. These are about 15 miles southeast of Fish Springs, on the road from Mecca down the west side of the Colorado Desert.



View of a mountain of limestone. Waters' Group of Claims.
Fish Mountains, Imperial County.

The water is so salt as to be scarcely potable and near by are other springs whose water is entirely undrinkable. Soda Springs are at the base of a low barren knoll, one-half to three-quarters of a mile south of Clay Point, marked by a government bench mark, around which

the road turns west on the way from Mecca to Seventeen Palms Springs. The road from Clay Point south toward Harper Well is very little traveled and is difficult to find.

Fish Springs. Fish Springs (230 feet below sea level), in 1908 submerged to a depth of about 25 feet beneath Salton Sea, are a group of strong natural springs whose aggregate yield is several miner's inches. The waters are tepid and slightly saline, but of sufficiently good quality to be used by men or animals without injurious effects. Before their submergence, these springs were especially important to travelers because they were at the southernmost point at which water of fair quality can be procured in abundance along the west side of the desert until Harper (Mesquite) Well is reached. They will emerge again as the lake shrinks by evaporation, and when the lake water has become too saline for use they will again become important. Their position is indicated by a prominent rocky point which stands out in a desert about a mile east of the Santa Rosa Mountains, and which is conspicuous not only because of its position but because of the distinct water line that encircles it 10 to 15 feet below its summit. This point is about 2 miles northeast of the springs.

Frinks Springs. These are about 6 miles northwest of Frinks Station, on the Southern Pacific Railroad. They are on one of the old wagon roads from San Bernardino to Yuma, near the old beach line that stands about 40 feet above sea level in the Colorado Desert. The water is of good quality and in fair quantity.

McCain Springs. These springs are about 5 miles somewhat east of south of Clay Point, mentioned in the description of Soda Springs. They are in the center of a broad wash, locally called arroyo grande, and are marked by three large sand dunes from a quarter of a mile southwest. The surrounding country is traversed by numerous gulches from 6 to 20 feet in depth and often difficult to cross. The springs, which are well below sea level, have built up a small mound in the bed of the wash. The water appears to be charged with carbon dioxide gas and is fairly palatable.

Kane Spring. This is 6 miles east of Harper Well, on top of a low knoll. It is surrounded by cane, salt grass, and arrow weed. The water is full of soda and is very poor, being hardly fit for use.

Yuha Springs. These springs are located in a wash near the corner of Sec. 5, 6, 7, and 8 about 5 miles southeast of Coyote Well and a mile southwest of the derrick at the Yuha oil well. The stage road from San Diego to El Centro passes about 2 miles north of the springs. The water is impregnated with alkaline matter, but when used continuously is not unpleasant or harmful. In 1905 there was a trough and pump at the springs.

Sunset Springs. These springs, which have long been known, are about 13 miles south of east from Brawley, below the old beach which is so prominent a feature about the borders of the Colorado Desert. They are of less importance now than before the reclamation of so large a part of the Imperial Valley by irrigation with Colorado River water.

Bibl: U. S. G. S. Water Supply Paper No. 224, by W. C. Mendenhall from data of G. E. Bailey.

PUMICE.

Pumice is found at several places, especially interbedded with Tertiary sediments around Carrizo Creek and Superstition Mountain and east of the Salton Sea. The deposits on the Salton Sea have been worked for a number of years, and have produced a considerable tonnage. The material is of the vesicular, gray variety, and is sold for abrasive purposes.

California Pumice Deposit. This deposit is located in the obsidian buttes, on the southeast shore of the Salton Sea, in T. 11 S., R. 13 E., S. B. B. and M., 11 miles northwest of Calipatria. Calipatria Branch of the Pacific Southwest Trust and Savings Bank of Los Angeles, owner.

The pumice occurs on the east slope of a low, rounded hill, and is interbedded in the sediments. The pumice occurs in pieces that vary in size up to 12 inches, the average being about 2 to 4 inches. Only pieces over 2 inches are shipped. The material is mined in the open cuts by pick and shovel, and the pumice is sorted by hand. A team and scraper haul away the sand. Three men are employed.

Brand and Stevens Pumice Deposit. It is situated 9 miles northwest of Calipatria, in Sec. 33, T. 11 S., R. 13 E., S. B. B. and M., and consists of a group of placer claims embracing about a quarter section. Owners, H. W. Brand and E. E. Stevens, Los Angeles.

This deposit has been worked more or less continuously since 1917. The pumice covers probably 100 acres located on a low, rounded hill east of the Salton Sea. It has been mined from a large number of open cuts, to a depth of 15 feet. The pumice occurs in lumps of various sizes, the largest pieces not being over 10 inches, scattered throughout sediments that cover this area. The material is mined by pick and shovel. Pumice is sorted by hand, and teams and scrapers used to haul away the sand. The pumice is hauled to Estelle siding on the Southern Pacific Railroad, a distance of 7 miles. Six men are employed.

Bibl: State Mineralogist's Report XVII, pp. 270-271.

PYROPHYLLITE.

Pyrophyllite is a hydrous silicate of aluminum, $H_2Al_2Si_4O_{12}$. It resembles talc so closely in its properties it is generally classed as talc. It occurs in the schists and gneisses associated with cyanite, on the cyanite deposit owned by the Vitrifax Company, of Los Angeles near Ogilby. It is exposed in a number of places on the west contact of the deposit, and in workings shows widths of 6 to 8 feet. A number of years ago it was worked and shipped as talc.

SILICA.

Deposits of silica sand occur in the Coyote and Fish mountains that are suitable for the manufacture of glass.

Coyote Mountain Silica Deposit. A bedded deposit of silica sand occurs in the Coyote Mountains, in Sec. 1 and 2, T. 16 S., R. 9 E., S. B. B. and M., on the holdings of the Columbia Cement Company.

The deposit is located 7 miles north of Coyote Wells, a station on the San Diego and Arizona Railroad.

The bed of silica is about 50 feet thick and can be traced for one-quarter of a mile along a gulch west of No. 3 Marble Quarry. The sand is clean and white, and is suitable for the manufacture of glass. During 1921 and 1922 1200 tons of this sand was shipped to Los Angeles, and the price received for the product was \$6.00 per ton.

Bibl: State Mineralogist's Report XVII, p. 271.

Fish Mountain Silica Deposit. This deposit of silica sand is located in the Fish Mountains, in Sec. 10 and 15, T. 14 S., R. 9 E., S. B. B. and M., 14 miles north of Coyote Wells, a station on the San Diego and Arizona Railroad. Owner, W. A. Waters, of Dixieland.



Exposure of salt cake (thenardite) in west open-cut, Bertram Sodium Sulphate Deposit, Imperial County. Photo by E. N. Smith.

Analysis and screening test made by John T. Rice, chemist, is as follows:

Sample of Silica on 50 mesh and 50% of original		Sample of Silica minus 50 mesh
Silica (SiO_2)	86.00%	75.06%
Aluminum Oxide (Al_2O_3)	8.36%	19.23%
Iron Oxide (Fe_2O_3)	1.18%	.63%
Calcium Oxide (CaO)	3.06%	3.45%
Magnesium Oxide (MgO)	T ₂	0.11%
Alkalies	.11%	.09%
Loss in Ignition	1.24%	1.27%
Totals	99.95%	99.877%

SODIUM SULPHATE.

Bertram Sodium Sulphate Deposit is located $2\frac{1}{2}$ miles northeast of Bertram station on the Southern Pacific Railroad, in Sec. 19, T. 9 S.,

R. 12 E., S. B. B. and M. Elevation 125 feet below sea level. Holdings consist of 320 acres. Owner, E. N. Smith, El Centro, California.

The deposit is mainly thenardite, anhydrous sodium sulphate, which has a crystal form distinct from that of mirabilite, and is not so subject to alteration on exposure to the air. Mirabilite, glauber salt, is here associated with thenardite, usually on the top of the strata of thenardite. These parallel strata of sodium sulphate occur in the consolidated clay beds and sandstones which are extensively folded. The general strike of these beds is N. 70° W., dip 30° to 40° N. The above mentioned strata of thenardite have a thickness varying from 8 inches to 3 feet. The proved area containing sodium sulphate is about one-half mile wide and about 3000 feet in length. Samples taken from borings throughout this area are reported to carry 10 to 12% sodium



Salt cake deposit (mainly thenardite) at Bertram station in the Salton Basin, Imperial County. Photo by E. N. Smith.

sulphate. Workings consist of two open cuts; the one on the east end of the deposit is 600 feet long and 14 feet deep, the other which is located on the west end of the deposit, is 200 feet in length by 14 feet deep. During the early part of 1923, 2500 tons of salt cake was extracted and shipped by E. H. Otto and Company, of San Francisco.

Samples of the sodium sulphate crystals collected by E. N. Smith were analyzed by Smith, Emery and Company, of Los Angeles, as follows:

Analysis of Sodium Sulphate from Bertram, California. Sample No. 1.

Water Insoluble	Trace
Iron and Aluminum Oxides	None
Calcium Oxide (CaO)	None
Magnesium Oxide (MgO)	Trace
Sodium Oxide (Na ₂ O)	43.64%
Moisture (105°)07%
Combined Water12%
Chlorine (Cl)10%
Boric Anhydride (B ₂ O ₃)	None
Sulphuric Anhydride (SO ₃)	56.22%
Total	100.15%

Hypothetical Combination :

Sodium Sulphate (Na_2SO_4)	99.80%
Sodium Chloride (NaCl)	.16%
Magnesium Sulphate (MgSO_4)	Trace
Moisture and Combined Water	.19%
Total	100.15%

Sodium sulphate is used in the making of wood pulp in the United States by the so-called sulphite process. It is also used in the manufacture of glass.

Bibl: State Mineralogist's Report XX, pp. 87-91.



Bertram salt cake deposit in Salton Basin, Imperial County, showing steam shovel at east open-cut.
Photo by E. N. Smith.

STONE INDUSTRY.

(Sand and Crushed Rock.)

Due to the rapid growth of the cities of Imperial Valley, the demand for these building materials has lead to establishment of a rock crushing plant at Frink siding on the Southern Pacific Railroad.

Orange County Rock Company, Inc. H. G. Wright, president, O. W. Bachman, secretary, Orange, California. E. S. Cook, manager. Offices: El Centro.

The crushing plant is located at Frink siding, on the Southern Pacific Railroad. The capacity of the plant is 1500 tons per day. The material used is unconsolidated wash, containing boulders of schist, rhyolite, andesite and granitic gneiss. The gravel pit is located one mile north of the plant in the Coffey Spring wash from the Chocolate Mountains. The gravel from the pit is loaded into Western side dump cars by P. & H. Company steam shovel, and the train of cars is hauled by Plymouth gasoline motor, over broad gauge track to crushing plant. At the plant the material is crushed, washed and screened and the following products produced:

No. 1— $1\frac{1}{2}$ " to $2\frac{1}{4}$ ".

No. 2—1" to $1\frac{1}{2}$ ".

No. 3— $\frac{1}{2}$ " to 1".

No. 4— $\frac{3}{16}$ " to $\frac{1}{2}$ ".

The plant is driven by a 75-h.p. Semi-Diesel engine. Water for washing purposes is secured from Frink Springs. Twelve to fifteen men are employed.

Dixieland Sand and Gravel Company, E. S. Cook, of El Centro, owner. This plant, consisting of elevator, revolving screen and storage bin, is located three miles west of Dixieland, near the state highway. The sand is delivered to the plant by scrapers. Four men are employed.

STRONTIUM.

Near the Fish Mountain gypsum deposit is a considerable body of celestite or strontium sulphate, capping a low hill on the north side of Fish Mountain. Here the celestite occurs in tilted sedimentary beds that are probably of Tertiary age. The deposit is 26 miles north of Plaster City, a station on the San Diego and Arizona Railroad, and several miles north of the Pacific Portland Cement Company's gypsum quarry.

The celestite deposit is the result of precipitation and is underlain by beds of gypsum. The ore is finely crystalline, and generally white in color. Several carloads were mined and shipped from this deposit during the early part of 1917 for the manufacture of strontium nitrate.

Bibl: State Mineralogist's Report XVII, pp. 271-272.

SULPHUR.

There are small exposures of sulphur on the east slope of Coyote Mountain, and also on the southeastern slope of the Chocolate Range of mountains.

Coyote Mountain Sulphur Deposit. It is located in SE $\frac{1}{4}$ of Sec. 6, T. 16 S., R. 10 E., S. B. B. and M., about 7 miles north of Coyote Wells, a station on the San Diego and Arizona Railroad. Elevation 500 feet. A claim has been located on the deposit by M. A. Turner and associates, of San Diego.

The sulphur occurs along a fault fissure that strikes N. 70° E., which is 8 to 10 feet wide. The sulphur is apparently along fractures and

seams in the rock. The outcrop is about 100 feet in length, and stands 20 feet above the surrounding country rock which is granite, schist and limestone.

Development consists of a short crosseut tunnel and open cut. Idle.

Full Moon Sulphur Deposit. It is located on the southwestern slope of the Chocolate Range of mountains, in Sec. 36, T. 10 S., R. 16 E., S. B. B. and M., 8 miles north of Iris siding on the Southern Pacific Railroad. Holdings comprise five claims known as the Full Moon Group. Owner, J. Thebo, La Mesa, California.

The deposit at this place seems to have been formed through solfataric action, the sulphur being deposited near the surface in fractures and seams of the adjacent rock, which is tufa. The principal showings are in an open cut 12 feet deep and 40 feet in length. Here pure sulphur is found in the seams of the rock, and is also scattered throughout the rock. The deposits appear to be superficial, and the rock impregnated by sulphur is about 10 to 15 feet thick. Considerable development has been done on the deposit in the way of shafts, open cuts and tunnels. Idle.



OIL FIELD DEVELOPMENT OPERATIONS.

By R. D. BUSH, State Oil and Gas Supervisor.

From January 31, 1926, to and including May 1, 1926, the following new wells were reported as ready to drill:

Company	Sec.	Twp.	Range	Well No.	Field
ALAMEDA COUNTY:					
George L. Craig.....	14	3	3	1	
COLUSA COUNTY:					
W. B. Brown.....	31	15	4	1	
FRESNO COUNTY:					
Confidence Oil Co.....	31	19	15	17	Coalinga
Pacific Oil Co.....	31	20	15	72	Coalinga
Premier Oil Co.....	24	20	14	16	Coalinga
Standard Oil Co.....	25	20	14	115	Coalinga
Superior Oil Co.....	31	20	15	8-B	Coalinga
Fresno United Oil Co.....	23	15	18	3	
Taylor Oil Co.....	5	13	22	1	
HUMBOLDT COUNTY:					
Eureka Oil Co.....	21	4	1	1	
KERN COUNTY:					
Union Oil Co.....	16	28	20	Miller & Lux 1	Belridge
Union Oil Co.....	23	28	20	Theta 1	Belridge
Devils Den Products Co.....	23	25	18	3	Devils Den
Pacific Oil Co.....	35	30	24	208	Elk Hills
C. C. M. O. Co.....	9	29	28	16	Kern River
Del Rey Oil Co.....	5	29	28	West 10	Kern River
George F. Getty.....	14	28	27	Lehnhardt 6	Kern River
George F. Getty.....	14	28	27	Lehnhardt 14	Kern River
George F. Getty, Inc.....	22	28	27	Tegeler 6	Kern River
George F. Getty, Inc.....	22	28	27	Tegeler 14	Kern River
Marland Oil Co.....	16	28	27	Cauley 139	Kern River
Cymric Oil Co.....	26	29	21	4	McKittrick
Wellington Oil Co.....	2	30	21	1	McKittrick
Associated Oil Co.....	20	31	23	2	Midway
Associated Oil Co.....	2	31	22	71	Midway
Balboa Oil Co.....	24	31	23	27	Midway
Balboa Oil Co.....	24	31	23	41	Midway
Balboa Oil Co.....	24	31	23	54	Midway
Balboa Oil Co.....	24	31	23	55	Midway
Big Ten Oil Co.....	36	32	23	25	Midway
California Petroleum Corp.....	34	32	24	Dorothy 5	Midway
California Star Oil Co.....	26	31	22	10-A	Midway
Caribou Oil Mining Co.....	32	31	23	12	Midway
E. & M. Oil Co.....	10	31	22	12	Midway
General Petroleum Corp.....	19	31	23	2	Midway
King G. Gillette.....	21	31	22	A-3	Midway
King G. Gillette.....	21	31	22	A-4	Midway
King G. Gillette.....	21	31	22	B-2	Midway
King G. Gillette.....	21	31	22	B-3	Midway
Honolulu Consolidated Oil Co.....	4	32	24	11	Midway
Honolulu Consolidated Oil Co.....	4	32	24	21	Midway
Honolulu Consolidated Oil Co.....	4	32	24	22	Midway
Honolulu Consolidated Oil Co.....	4	32	24	25	Midway
Honolulu Consolidated Oil Co.....	8	32	24	38	Midway
Honolulu Consolidated Oil Co.....	4	32	24	41	Midway
Honolulu Consolidated Oil Co.....	4	32	24	42	Midway
Honolulu Consolidated Oil Co.....	8	32	24	48	Midway
Honolulu Consolidated Oil Co.....	4	32	24	64	Midway
North American Oil Cons.....	32	31	24	6	Midway
North American Oil Cons.....	30	31	24	29	Midway
North American Oil Cons.....	30	31	24	30	Midway
North American Oil Cons.....	30	31	24	34	Midway
North American Oil Cons.....	30	31	24	36	Midway
North American Oil Cons.....	30	31	24	39	Midway
North American Oil Cons.....	30	31	24	40	Midway
North American Oil Cons.....	30	31	24	41	Midway

OIL FIELD DEVELOPMENT OPERATIONS—Continued.

Company	Sec.	Twp.	Range	Well No.	Field
KERN COUNTY—Continued.					
North American Oil Cons.	30	31	24	42	Midway
Pacific Oil Co.	33	31	24	13	Midway
Pacific Oil Co.	33	31	24	15	Midway
Pacific Oil Co.	29	31	24	41	Midway
Pacific Oil Co.	3	32	24	42	Midway
Pacific Oil Co.	19	31	24	53	Midway
Pacific Oil Co.	19	31	24	54	Midway
Pacific Oil Co.	33	31	24	54	Midway
Pacific Oil Co.	33	31	24	59	Midway
Pacific Oil Co.	5	32	24	62	Midway
Pan American Petroleum Co.	19	31	23	4	Midway
Pan American Petroleum Co.	19	31	23	5	Midway
Security Development Co.	15	31	22	11	Midway
Standard Oil Co.	29	31	24	43	Midway
Standard Oil Co.	33	31	24	50	Midway
Standard Oil Co.	33	31	24	53	Midway
Standard Oil Co.	19	31	24	55	Midway
Standard Oil Co.	31	31	24	61	Midway
Standard Oil Co.	31	31	24	62	Midway
Union Oil Co.	32	31	24	Buena Vista 4	Midway
The United Oil Co.	6	31	23	1	Midway
The United Oil Co.	19	31	23	Calidon 6	Midway
The United Oil Co.	20	31	23	United 2	Midway
The United Oil Co.	20	31	23	United 3	Midway
Valley Oil Co.	14	31	22	6	Midway
Western Production Co.	21	31	22	5	Midway
Lewis Petroleum Co.	34	12	24	G-M 13	Sunset
Lewis Petroleum Co.	34	12	24	G-M 14	Sunset
Lewis Petroleum Co.	34	12	24	G-M 15	Sunset
Obispo Oil Co.	32	12	23	11	Sunset
The United Oil Co.	32	12	23	Transport 2	Sunset
Standard Oil Co.	27	11	20	Kern Co. Lease	
Robert Barry	35	26	18	No. 2 23	Wheeler Ridge
Buchner Brothers	22	26	28	2	
George F. Getty, Inc.	20	27	27	Marland 1	
B. C. Mackey	23	11	11	1	
Marland Oil Co.	27	26	20	Lazard 1	
R. B. McIlroy	3	10	23	1	
Milham Exploration Co.	16	28	23	Hyde 1	
Milham Exploration Co.	32	11	22	Pioneer 1	
Shell Co.	9	27	28	Vedder 1	
Joseph Stalder	12	11	23	1	
LOS ANGELES COUNTY:					
Shell Co.	33	3	13	Reyes 32	Dominguez
Shell Co.	34	3	13	Reyes 33	Dominguez
Shell Co.	33	3	13	Reyes 101	Dominguez
Shell Co.	33	3	13	Reyes 3-B	Dominguez
Union Oil Co.	33	3	13	Callender 13	Dominguez
Union Oil Co.	33	3	13	Callender 14	Dominguez
Union Oil Co.	33	3	13	Hellman 14	Dominguez
Pacific Oil Co.	17	2	14	46	Inglewood
Pacific Oil Co.	8	2	14	Baldwin 37	Inglewood
Pacific Oil Co.	17	2	14	Baldwin 51	Inglewood
Standard Oil Co.	16	2	14	Baldwin 61	Inglewood
Standard Oil Co.	17	2	14	L. A. Invest. 1 42	Inglewood
Standard Oil Co.	17	2	14	L. A. Invest. 1 43	Inglewood
Standard Oil Co.	17	2	14	L. A. Invest. 1 44	Inglewood
Standard Oil Co.	16	2	14	Stocker 5	Inglewood
Standard Oil Co.	7	2	14	Vickers 2 10	Inglewood
Francis D. Adams	13	4	13	1	Long Beach
Ambassador Petroleum Co.	13	4	13	Ambassador A-1	Long Beach
Ambassador Petroleum Co.	18	4	12	Ambassador A-2	Long Beach
B. K. & M. Oil Co.	13	4	13	Brown 1	Long Beach
B. K. & M. Oil Co.	13	4	13	Gibson 1	Long Beach
Barham & Leeper Oil Co.	18	4	12	1	Long Beach
Braly & Slade No. 3	13	4	13	Tetenman 1	Long Beach

OIL FIELD DEVELOPMENT OPERATIONS—Continued.

Company	Sec.	Twp.	Range	Well No.	Field
LOS ANGELES COUNTY—Cont.					
Breslin, Woodward & Sheedy	13	4	13	Breslin, Woodward & Sheedy 2	Long Beach
Breslin, Woodward & Sheedy	13	4	13	Breslin, Woodward & Sheedy 3	Long Beach
Breslin, Woodward & Sheedy	13	4	13	Breslin, Woodward & Sheedy 4	Long Beach
J. W. Bucklin	13	4	13	Bucklin 1	Long Beach
Bush-Voorhis Oil Co.	13	4	13	16	Long Beach
California Petroleum Corp.	13	4	13	Frye 1	Long Beach
California Petroleum Corp.	13	4	13	Frye 2	Long Beach
California Petroleum Corp.	18	4	12	Jotham Bixby 1	Long Beach
California Petroleum Corp.	24	4	13	Otto Comm. 1	Long Beach
C. W. Camp	13	4	13	Camp 1	Long Beach
Casa Blanca Oil Co.	19	4	12	Casa Blanca 3	Long Beach
B. H. Cochran	13	4	13	Cochran 1	Long Beach
Charles B. Colby	13	4	13	Extension 1	Long Beach
Craig, Burns & Co., Inc.	13	4	13	Delaney 18	Long Beach
Davis & MacMillan Co.	13	4	13	11	Long Beach
A. J. Delaney	13	4	13	Delaney 7	Long Beach
A. J. Delaney	13	4	13	Delaney 10	Long Beach
A. J. Delaney	13	4	13	Delaney 11	Long Beach
A. J. Delaney	13	4	13	Delaney 14	Long Beach
A. J. Delaney	13	4	13	Delaney 16	Long Beach
A. J. Delaney	13	4	13	Delaney 17	Long Beach
A. J. Delaney	18	4	12	Delaney 20	Long Beach
A. J. Delaney	13	4	13	Delaney 21	Long Beach
A. J. Delaney	13	4	13	Delaney 23	Long Beach
A. J. Delaney	13	4	13	Delaney 24	Long Beach
A. J. Delaney	13	4	13	Delaney 25	Long Beach
A. J. Delaney	13	4	13	Delaney 29	Long Beach
A. J. Delaney	13	4	13	Delaney 30	Long Beach
A. J. Delaney	13	4	13	Delaney 31	Long Beach
L. T. Edwards	13	4	13	Hines 1	Long Beach
Elbe Oil Land Development Co.	13	4	13	Elbe 7	Long Beach
Elbe Oil Land Development Co.	13	4	13	Elbe 8	Long Beach
Featherstone & Preston	13	4	13	Featherstone 16	Long Beach
W. F. Garrison	19	4	12	Felicia M.	
Gem Oil Co.	13	4	13	Hogan 1	Long Beach
General Petroleum Corp.	19	4	12	2	Long Beach
George F. Getty, Inc.	13	4	13	K. & H. 7	Long Beach
George F. Getty, Inc.	13	4	13	L. B. 14	Long Beach
George F. Getty, Inc.	13	4	13	L. B. 15	Long Beach
George F. Getty, Inc.	13	4	13	L. B. 16	Long Beach
J. R. Gray	18	4	12	1	Long Beach
Halbert & Smith	13	4	13	1	Long Beach
Henderson Petroleum Corp.	13	4	13	26	Long Beach
Hornaday Oil Co.	13	4	13	1	Long Beach
George W. Johnson	13	4	13	7	Long Beach
George W. Johnson	13	4	13	4-A	Long Beach
F. S. Jones	13	4	13	1	Long Beach
Julian Petroleum Corp.	13	4	13	Bruce 1	Long Beach
Julian Petroleum Corp.	13	4	13	Chandler 1	Long Beach
Julian Petroleum Corp.	13	4	13	Fee 1	Long Beach
Julian Petroleum Corp.	13	4	13	Fee 2	Long Beach
Julian Petroleum Corp.	13	4	13	Fee 3	Long Beach
Julian Petroleum Corp.	13	4	13	Hughes 1	Long Beach
Julian Petroleum Corp.	13	4	13	Laughlin 1	Long Beach
Julian Petroleum Corp.	13	4	13	Mills 1	Long Beach
Kaweah Petroleum Co.	13	4	13	Kaweah 1	Long Beach
Keck Syndicate No. 5	13	4	13	Modoc 4	Long Beach
Keck Syndicate No. 5	13	4	13	Modoc 5	Long Beach
Kenney & Macrate	13	4	13	Kenney & Macrate 3	Long Beach
W. Irving Lake	13	4	13	2	Long Beach
W. C. Lance	13	4	13	1	Long Beach

OIL FIELD DEVELOPMENT OPERATIONS—Continued.

Company	Sec.	Twp.	Range	Well No.	Field
LOS ANGELES COUNTY—Cont.					
Law & Sanders.....	13	4	13	1	Long Beach
Lindauer Oil Co.....	13	4	13	6	Long Beach
Lindauer Oil Co.....	13	4	13	7	Long Beach
Lindauer Oil Co.....	13	4	13	8	Long Beach
Lindauer Oil Co.....	13	4	13	10	Long Beach
Magnolia Petroleum Syn. No. 1.....	13	4	13	2	Long Beach
Marine Corp.....	13	4	13	55	Long Beach
Marine Corp.....	13	4	13	56	Long Beach
Marine Corp.....	13	4	13	60	Long Beach
McKeon Drilling Co., Inc.....	13	4	13	Pantages 1	Long Beach
M. W. McVey.....	13	4	13	McVey 1	Long Beach
George E. Merrill.....	13	4	13	1	Long Beach
E. J. Miley.....	13	4	13	Los Cerritos 3	Long Beach
E. J. Miley.....	13	4	13	Los Cerritos 4	Long Beach
Northwest Gasoline Co.....	13	4	13	1	Long Beach
J. E. O'Donnell.....	13	4	13	O'Donnell 55	Long Beach
Ort & Homer.....	18	4	12	1	Long Beach
Painted Hills Oil Assn.....	13	4	13	10	Long Beach
Pan American Petroleum Co.....	19	4	12	Chainey 2	Long Beach
R. F. Parks.....	13	4	13	Hale-Parks 1	Long Beach
Peacock & Lyons.....	13	4	13	1	Long Beach
W. A. Playter.....	13	4	13	Bunny 2	Long Beach
W. A. Playter.....	18	4	12	Bunny 3	Long Beach
Queen & Scott.....	13	4	13	Scott 2	Long Beach
Raburne Oil Co.....	13	4	13	3	Long Beach
Repetto Hills Petroleum Corp.....	13	4	13	5	Long Beach
Retsof Drilling Co.....	13	4	13	78-A	Long Beach
Ring Petroleum Corp.....	13	4	13	5-A	Long Beach
J. T. Robertson Co.....	13	4	13	5	Long Beach
S. M. & F. Oil Co.....	18	4	12	S. M. & F. 1	Long Beach
San Martinez Oil Co.....	29	4	12	Booth Comm. 6	Long Beach
Sharp & Redick.....	13	4	13	Sharp-Redick 1	Long Beach
Southern States Petroleum Corp.....	13	4	13	4	Long Beach
Star Petroleum Co.....	13	4	13	Colby 2	Long Beach
Walter P. Temple Oil Co.....	13	4	13	2	Long Beach
Walter P. Temple Oil Co.....	18	4	12	4	Long Beach
Walter P. Temple Oil Co.....	13	4	13	5	Long Beach
Walter P. Temple Oil Co.....	18	4	12	Olson 1 3	Long Beach
W. O. Todd.....	18	4	12	2	Long Beach
United Oil Co.....	13	4	13	American 1	Long Beach
United Oil Co.....	13	4	13	American 2	Long Beach
United Oil Co.....	13	4	13	Barnes 1	Long Beach
United Oil Co.....	13	4	13	Ketchum 1	Long Beach
Vlasnik & Roberts.....	13	4	13	Vlasnik & Roberts 1	Long Beach
W. M. C. Oil Co.....	13	4	13	2	Long Beach
W. M. C. Oil Co.....	13	4	13	3	Long Beach
Harry Williamson.....	13	4	13	Harry William-son 1	Long Beach
Wilshire Oil Co., Inc.....	13	4	13	Wilshire A-2	Long Beach
Wilshire Oil Co., Inc.....	13	4	13	Wilshire A-3	Long Beach
Wilshire Oil Co., Inc.....	13	4	13	Wilshire B-1	Long Beach
Wilshire Oil Co., Inc.....	13	4	13	Wilshire B-2	Long Beach
Wilshire Oil Co., Inc.....	13	4	13	Wilshire C-1	Long Beach
Wilshire Oil Co., Inc.....	13	4	13	Wilshire C-2	Long Beach
Wilshire Oil Co., Inc.....	13	4	13	Wilshire D-1	Long Beach
McGinley Oil Co.....	6	2	11	3-B	Montebello
St. Helens Petroleum Co., Ltd.....	2	2	12	Mulholland 3	Montebello
St. Helens Petroleum Co., Ltd.....	6	2	11	Piuma-Briano 5	Montebello
St. Helens Riverside Properties.....	2	2	12	Monterey 12	Montebello
Standard Oil Co.....	6	2	11	Baldwin 66	Montebello
Standard Oil Co.....	6	2	11	Baldwin 67	Montebello
Standard Oil Co.....	2	2	12	Harvey 1	Montebello
Standard Oil Co.....	2	2	12	Howard & Smith 3	Montebello
Standard Oil Co.....	6	2	11	Temple 17	Montebello
Union Oil Co.....	2	2	12	La Merced 28	Montebello
Henry R. Dabney.....	8	3	16	McCormick 1	Newhall

OIL FIELD DEVELOPMENT OPERATIONS—Continued.

Company	Sec.	Twp.	Range	Well No.	Field
LOS ANGELES COUNTY—Cont.					
Barnsdall Oil Co.	18	3	13	O'Dea 10	Rosecrans
Barnsdall Oil Co.	18	3	13	O'Dea 11	Rosecrans
Barnsdall Oil Co.	18	3	13	O'Dea 12	Rosecrans
Fred E. Cole	18	3	13	1	Rosecrans
General Petroleum Corp.	18	3	13	Vaughn 3	Rosecrans
Union Oil Co.	18	3	13	Howard Park 27	Rosecrans
Bandini Petroleum Co.	5	3	11	Off 7	Santa Fe Springs
California Petroleum Corp.	5	3	11	Wickman 2-B	Santa Fe Springs
General Petroleum Corp.	5	3	11	Santa Fe 20	Santa Fe Springs
C. C. M. O. Co.	9	4	14	Del Amo 52	Torrance
C. C. M. O. Co.	9	4	14	Del Amo 58	Torrance
C. C. M. O. Co.	9	4	14	Del Amo 63	Torrance
C. C. M. O. Co.	8	4	14	Del Amo 68	Torrance
C. C. M. O. Co.	8	4	14	Del Amo 74	Torrance
C. C. M. O. Co.	8	4	14	Del Amo 98	Torrance
C. C. M. O. Co.	10	4	14	Torrance 99	Torrance
California Petroleum Corp.	5	4	14	Redondo Imp.	
				Co. 5	Torrance
Fullerton Oil Co.	8	4	14	Waddell 6	Torrance
Petroleum Securities Co.	22	4	14	Hogan 1	Torrance
R. & D. Oil Co.	9	4	14	2	Torrance
Shell Co.	8	4	14	Redondo	
				Comm. 1	Torrance
Shell Co.	8	4	14	Redondo	
				Comm. 9	Torrance
Shell Co.	8	4	14	Redondo	
				Comm. 11	Torrance
Shell Co.	9	4	14	Redondo Imp.	
				Co. 12	Torrance
Superior Oil Co.	24	4	14	Torrance 29	Torrance
W. E. McCaslin	17	2	11	Patten-Gregg 1	Whittier
Pan American Petroleum Co.	17	2	11	Broderick 1	Whittier
Petroleum Securities Co.	17	2	11	Rideout	
				Heights 1	Whittier
South Slope Oil Co.	16	2	11	Childs 3	Whittier
B. J. Jeffrey	7	1	14	2	
George W. Johnson	30	3	14	G. C. Martin 1	
Julian Petroleum Corp.	19	3	14	Hellman Bank	
				Trust 1	
Petroleum Securities Co.	36	4	14	Palos Verdes 1	
Shell Co.	11	5	12	Bryant 4	
Standard Oil Co.	15	2	15	University 1	
Union Oil Co.	2	5	12	Bryant 1	
NAPA COUNTY:					
H. Rambke	29	8	3	2	
ORANGE COUNTY:					
Birch Oil Co.	2	3	10	1-A	Brea Olinda
Shell Co.	1	3	10	Fisher 4	Brea Olinda
Shell Co.	2	3	10	Orange 11	Brea Olinda
Shell Co.	2	3	10	Orange 12	Brea Olinda
Shell Co.	2	3	10	Orange 13	Brea Olinda
Shell Co.	2	3	10	Pico 5	Brea Olinda
Union Oil Co.	6	3	9	Stearns 68	Brea Olinda
California Petroleum Corp.	28	5	11	Buck 1	Huntington Beach
Golden Dome Oil Co.	2	6	11	Ward 1-A	Huntington Beach
Standard Oil Co.	3	6	11	Huntington B 45	Huntington Beach
Standard Oil Co.	3	6	11	Huntington	
				B B-46	Huntington Beach
Standard Oil Co.	12	6	11	Thomson 7	Huntington Beach
The United Oil Co.	2	6	11	Pacific 1	Huntington Beach
Bar-Mor Petroleum Corp.	21	6	10	1	Newport
Julian Petroleum Corp.	21	6	10	Mesa 6	Newport
Owl Oil Co.	28	6	10	2	Newport
California Petroleum Corp.	28	3	9	Yarnell 19	Richfield
California Petroleum Corp.	28	3	9	Yarnell 20	Richfield
General Petroleum Corp.	28	3	9	Stern 6	Richfield

OIL FIELD DEVELOPMENT OPERATIONS—Continued.

Company	Sec.	Twp.	Range	Well No.	Field
ORANGE COUNTY—Continued.					
Herndon-Hunter.....	29	3	9	1	Richfield
Standard Oil Co.....	34	3	9	Anaheim Union	
				Water Co. 1	Richfield
Standard Oil Co.....	29	3	9	Kraemer 2 21	Richfield
Union Oil Co.....	29	3	9	Coyle 5	Richfield
Union Oil Co.....	29	3	9	J. W. Newell 5	Richfield
SAN MATEO COUNTY:					
Steele Brothers.....		7	4	1	
SANTA BARBARA COUNTY:					
Searoad Asphaltum & Ref. Co.....		4	25	2	
Searoad Asphaltum & Ref. Co.....		4	25	4	
STANISLAUS COUNTY:					
J. G. Tavares.....	12	7	8	1	
VENTURA COUNTY:					
Montebello Oil Co.....	4	3	19	Shiells 93	Bardsdale
Surprise Oil Syn.....	33	2	20	14	Conejo
B. B. & N. Oil Co.....	13	4	19	6	Piru
Temescal Petroleum Co.....	3	4	18	Landers 3	Piru
H. A. Ivers.....	1	4	20	8	Sespe
Sentinel Oil Co.....	5	5	19	1	Sespe
Hoyt S. Gale.....	29	2	21	Beardsley 2	Simi
Shell Co.....	33	3	20	Berylwood 1	Simi
Oak Ridge Oil Co.....	13	3	21	South	
				Mountain 7	South Mountain
Associated Oil Co.....	27	3	23	Lloyd 33	Ventura
G. J. Magenheimer.....	22	3	23	Hartman 1	Ventura
Petroleum Securities Co.....	28	3	23	Orton 1	Ventura
Shell Co.....	28	3	23	Edison 5	Ventura
Shell Co.....	28	3	23	Edison 8	Ventura
Shell Co.....	27	3	23	Gosnell 8-A	Ventura
Shell Co.....	28	3	23	Gosnell 21	Ventura
Shell Co.....	28	3	23	Gosnell 22	Ventura
Shell Co.....	29	3	23	Taylor 12	Ventura
Shell Co.....	28	3	23	Taylor 13	Ventura
H. V. Gentry Corp.....	1	1	21		
Standard Oil Co.....	17	2	22	Haydock 1	
Standard Oil Co.....	17	2	22	Valentine 1	
YUBA COUNTY:					
Thomas M. Blake.....	7	15	5	1	

SPECIAL ARTICLES.

Detailed technical reports on special subjects, the result of research work or extended field investigations, will continue to be issued as separate bulletins by the Bureau, as has been the custom in the past.

Shorter and less elaborate technical papers and articles by members of the staff and others are published in each number of 'Mining in California.'

These special articles cover a wide range of subjects both of historical and current interest; descriptions of new processes, or metallurgical and industrial plants, new mineral occurrences, and interesting geological formations, as well as articles intended to supply practical and timely information on the problems of the prospector and miner, such as the text of new laws and official regulations and notices affecting the mineral industry.

THE FEDERAL REVENUE ACT AND THE MINING INDUSTRY.

It appears to be the consensus of opinion that the new federal revenue act, which was approved and signed by President Coolidge February 26, 1926, has dealt fairly with the mining industry and that operators should be gratified by the inclusion therein of a number of favorable provisions.

That the new law will reduce the tax burden of the industry and greatly simplify procedure is gathered from an analysis of the act in its relation to the mining industry, by Robert Murray Haig¹, Engineering and Mining Journal-Press; a feature article on the subject in the Mining Congress Journal, March 1926; and other published comment.

Briefly, the outstanding features of the new law are stated to be the repeal of the capital stock tax and changes in the discovery and depletion clauses in relation to oil and gas wells and ore deposits. The law reduces the surtax rate to a maximum of 20%; increases the corporation tax to 13% for 1925 and to 13½% for 1926 and subsequent years; and fixes oil depletion at 27½% of gross income. Rates on individuals have also been reduced.

Capital stock tax.

The repeal of this tax will relieve mining companies of considerable direct expense as well as simplifying corporate accounting, as it will no longer be necessary to file reports covering two different accounting periods. The former tax was especially burdensome on mining enterprises in the development stage.

Depletion.

On account of difficulties in the administration of the discovery depletion provision of the law in the case of oil and gas wells, an amendment was adopted which provides that in the case of oil and gas wells the allowance for depletion shall be 27½ per cent of the gross income from the property during the taxable year, subject, however, to the limitation that such allowance shall not exceed 50 per cent of the

¹ Haig, Robert Murray, "Analysis of the Federal Revenue Act of 1926," Engineering and Mining Journal-Press, Vol. 121, No. 10, March 6, 1926.

net income computed without deducting depletion. Some consideration was given to the question of placing mine depletion on a percentage basis; but brief discussion made it apparent that a percentage could not be agreed upon which would be acceptable to all branches of the mining industry. Short-life lead and zinc mines would be entitled to a higher rate than long-life copper and iron mines; coal mines would require a different rate from metal mines; and the possibility of securing an adequate rate for each class or group was so slight, and the danger of jeopardizing the principle so great, that the subject was dropped.

In any event, the new law is intended to reduce the aggregate depletion allowance to the oil industry, and to increase slightly the aggregate allowance for discovery depletion to the mining industry.

Mineral discoveries.

The administration of the discovery depletion provision never has been satisfactory either to taxpayers or to the income tax unit. Differences of opinion among the valuation engineers of the mining section of the income tax unit, as well as between the engineers and representatives of the taxpayers, operated to prevent the proper application of the law to mineral discoveries. The departmental interpretation that finally prevailed so circumscribed the law that it applied only to a few isolated cases where discoveries were made in tracts on which practically no mining operations had occurred. The department in 1924 attempted to correct this injustice by an amendment to the regulations which permitted the allowance of discovery value in the case of "one or more separate new ore bodies which have not been and could not have been included in any prior valuation."

The new law provides that discoveries shall include minerals in commercial quantities contained within a vein or deposit discovered in an existing mine or mining tract by the taxpayer after February 28, 1913, if the vein or deposit thus discovered was not merely the uninterrupted extension of a continuing commercial vein or deposit already known to exist and if the discovered minerals are of sufficient value and quantity that they could be separately mined and marketed at a profit.

It is a well-known fact that old mines in California, Colorado and Nevada have recently been opened up and in many cases new and valuable ore deposits discovered therein. It is clearly the intention of Congress that this provision should extend to such ore deposits since they are true discoveries having no relation to or connection with the ores previously extracted from these mines. In the case of an interrupted or separate vein or other formation, where, by reason of faults, dykes, or displacements, or lack of mineralization, the vein or deposit could not have been known to exist except through prospecting, exploration and discovery, discovery value should be allowable, and is as fully justified as in the case of a discovery of mineral in so-called virgin territory.

Discovery depletion section of the act.

This section reads as follows:

Sec. 204 (c). The basis upon which depletion, exhaustion, wear and tear, and obsolescence are to be allowed in respect of any property shall be the same as is

provided in subdivision (a) or (b) for the purpose of determining the gain or loss upon the sale or other disposition of such property, except that

(1) In the case of mines discovered by the taxpayer after February 28, 1913, the basis for depletion shall be the fair market value of the property at the date of discovery or within thirty days thereafter, if such mines were not acquired as the result of purchase of a proven tract or lease, and if the fair market value of the property is materially disproportionate to the cost. The depletion allowance based on discovery value provided in this paragraph shall not exceed 50 per centum of the net income of the taxpayer (computed without allowance for depletion) from the property upon which the discovery was made, except that in no case shall the depletion allowance be less than it would be if computed without reference to discovery value. Discoveries shall include minerals in commercial quantities contained within a vein or deposit discovered in an existing mine or mining tract by the taxpayer after February 28, 1913, if the vein or deposit thus discovered was not merely the uninterrupted extension of a continuing commercial vein or deposit already known to exist, and if the discovered minerals are of sufficient value and quantity that they could be separately mined and marketed at a profit.

(2) In the case of oil and gas wells the allowance for depletion shall be $27\frac{1}{2}$ per centum of the gross income from the property during the taxable year. Such allowance shall not exceed 50 per centum of the net income of the taxpayer (computed without allowance for depletion) from the property, except that in no case shall the depletion allowance be less than it would be if computed without reference to this paragraph.

In line with this subject, the illuminating editorial in the Mining Congress Journal of March, 1926, which is accompanied by a table showing comparative profits and taxes paid by various industries, so clearly sets forth the excessive tax burden now borne by the mining industry, that it is here quoted in full.

TAXING THE MINING INDUSTRY.

"It is frequently said and generally accepted that the power to tax is the power to destroy. It is somewhat humiliating to the American Mining Congress to admit that after its efforts to secure fair treatment for the mining industry in the matter of federal taxation and the great advantage which has been brought to the mining industry by virtue of the depletion and discovery clauses of the internal revenue law, that the mining industry is still paying an amount of taxes largely in excess of the proportion paid by any other industry.

"There are many who have pretended to believe that the depletion clauses of all of the revenue acts since 1916 gave an undue advantage to the mining industry, and there are some who have pretended to believe that the discovery clause gave the mining industry an unjust and unfair advantage. There have been members of Congress in both the House and the Senate who have assailed these provisions, and a distinguished member of the Ways and Means Committee of the House recently made the statement that the present bill will entirely relieve the mining industry of all tax obligations. We have no doubt that this statement was made with full belief in its truthfulness.

"An investigation of the actual facts show conclusively that the mining industry is paying a larger share of taxes in proportion to its ability to pay than any other industry, and from the record there can be no inducement left to engage in the mining business. The development of mineral resources is necessarily filled with hazard. An engi-

Table Showing Summary of Gross Receipts, Net Profits, Taxes Paid and Percentages of Same for All Corporations by Industrial Divisions for Year 1923. Industrial Divisions Are Shown in the Order of Their Percentage to Net Income of Total Taxes Paid.

Industrial division	Gross receipts	Total profits before taxes paid	Per cent of profits to gross receipts	All taxes other than federal income	Federal income tax	Total taxes paid	Per cent of other than income tax to profits	Per cent of federal income taxes to profits	Per cent of total taxes to profits	Net profits after deducting all taxes	Per cent of net profits to gross receipts after total taxes paid
Mining and quarrying	\$4,876,767,550	\$139,447,912	2.86	\$99,258,420	\$30,777,039	\$130,035,459	71.18	22.07	93.25	\$9,412,453	1.19
Agriculture and related industries	774,423,891	65,438,295	8.45	19,133,271	9,790,743	28,924,014	29.20	15.00	44.20	36,514,281	4.72
Rubber and rubber goods	1,079,780,739	40,483,293	3.75	14,606,350	2,839,675	17,446,025	36.08	7.02	43.10	33,037,268	2.13
Leather and leather products	1,598,608,120	49,010,404	3.08	9,932,565	8,247,672	18,230,237	20.37	16.83	37.20	30,780,167	1.92
Public service, professional, amusements, hotels, etc.	2,420,815,395	184,929,163	7.64	44,763,787	20,376,829	65,140,616	24.21	11.02	35.23	119,788,547	4.95
Transportation and other public utilities	10,560,622,724	1,895,431,923	17.95	474,124,066	150,998,913	625,122,979	25.02	7.96	32.98	1,270,308,944	12.03
Finance, banking, insurance, etc.	8,752,174,665	1,296,464,539	14.82	322,297,327	95,114,379	417,411,706	24.86	7.34	32.20	879,052,833	10.04
Combinations of industries not ascertainable	800,620,301	60,119,141	7.50	11,239,777	5,209,962	16,449,737	18.70	8.66	27.36	43,669,404	5.45
Food products, beverages, and tobacco	10,085,841,519	490,375,027	4.86	72,103,984	55,646,300	127,750,284	14.70	11.34	26.04	362,624,743	3.60
Paper, pulp and products	1,445,827,777	117,936,925	8.15	17,892,023	12,232,699	30,124,722	15.17	10.37	25.54	87,812,203	6.07
Construction	2,226,569,284	88,899,466	4.00	11,000,848	11,438,833	22,439,681	12.38	12.86	25.24	66,459,785	2.99
Trade	32,299,071,061	1,134,667,194	3.51	152,012,085	128,536,444	280,548,529	13.40	11.33	24.73	84,118,665	2.64
Lumber and wood products	9,977,317,109	316,822,497	10.63	38,056,020	33,457,215	71,513,235	12.01	10.56	22.57	245,309,262	8.67
Textiles and textile products	7,869,734,405	574,849,007	7.30	62,942,103	65,435,092	128,377,112	10.95	11.38	22.33	446,471,895	5.24
Metals and metal products	16,683,264,555	1,477,828,375	8.89	165,317,527	160,770,716	326,088,243	11.19	10.88	22.07	1,151,740,132	6.92
Chemicals and allied products	6,191,373,554	508,514,921	8.30	55,447,815	49,426,373	104,874,188	10.90	9.72	20.62	403,639,833	6.59
Miscellaneous manufacturing industries	5,141,792,969	474,640,186	9.23	40,682,774	55,265,523	95,948,297	8.57	11.64	20.21	378,691,889	7.37
Printing and publishing	1,988,459,935	165,207,772	8.31	12,994,646	19,428,950	32,553,596	7.82	11.76	19.58	132,894,176	6.68
Stone, clay and glass	1,566,800,359	189,431,362	13.87	11,244,801	22,113,441	33,358,242	5.93	11.68	17.61	156,073,120	11.42

Data from pages 13, 14 and 15 of "Statistics of Income From the Returns of Net Income for 1923." Included in the net profits are tax-exempt interest and dividends received on capital stock of corporations. Net losses of previous years are not included as it is desirable to have the actual net profits for the year 1923 shown.

neer, who for many years represented a large eastern mining syndicate and who was authorized to secure options upon the most favorable prospects and to spend any reasonable amount of money in their development in order to determine whether his company should buy the property or surrender its option, is authority for the statement that not one in twenty of the prospects carefully selected and properly developed were found good enough after this development to justify the purchase by those whom he represented. This syndicate spent in some instances as much as \$100,000 in the development of a single prospect and thereafter surrendered the option because its investigations did not demonstrate that the property was worth the option price to his company.

"The many thousands of dry holes in oil prospecting, the many thousands of idle tunnels and shafts which decorate metal mining regions of the West are conclusive proof of the hazardous character of these enterprises. The great majority of these disastrous developments are not reported to the Internal Revenue Bureau in Washington. Only those companies report which either have made a profit or who might have been supposed to make a profit and, therefore, required to make a tax return.

"The Mining Congress Journal is startled to know the exact facts with relation to the profits earned by those companies which have made tax returns to the Internal Revenue Bureau of the Federal Government. We append a table showing the salient facts with reference to the returns for the year 1923. This table shows that the mining and quarrying industry, which includes oil and coal, paid in state and Federal taxes 93.25 per cent of its total net profits. It shows that after having paid its taxes there remained a net profit of nineteen hundredths of 1 per cent of its gross receipts as a profit, while the agricultural and related industries show a net profit of 4.72 per cent, transportation a net profit of 12.03 per cent, finance, banking, and insurance a net profit of 10.04 per cent. This table shows that the leather and leather products business, with the lowest profit next to mining, earned a profit of 1.92 per cent of its total gross receipts; and yet the net profit of this industry was a little more than ten times as great as the profits of mining, while the transportation industry earned a profit proportionately sixty-three times greater than mining. The mining industry furnishes more than half the total freight tonnage handled by the railroads and pays transportation rates which enables the transportation industry to earn a profit sixty-three times greater and always asking for more.

"In the percentages of these taxes paid to the Federal Government, the mining industry still stands at the head with a percentage of 22.07 per cent, which is approximately twice as great as the average of other branches of industry. In taxation to the state governments from its net profits 71.18 per cent is paid, and yet in the face of this startling condition there are those who believe the mining industry has been escaping its share of public support.

"While the Mining Congress Journal is greatly pleased with the outcome of the present legislative action in the framing of the new revenue act, at the same time we submit that the bill lacks much of doing justice to the mining industry and that in all of the states the mining industry is entitled to more careful consideration by state legis-

lative bodies; and we further submit that since mining is an industry which carries so much of hazard, and which develops so much of new taxable property, the state and Federal legislative bodies should look last to the mining industry for increased revenues rather than compel it to be the first called upon to defend itself against an increase of tax burdens."



ADMINISTRATIVE DIVISION.

WALTER W. BRADLEY, Deputy State Mineralogist.

Personnel.

There have been no changes of personnel to be noted during the past quarter.

Los Angeles Offices.

On March 7th, the offices of the District Engineer of the State Mining Bureau, also the offices of the Chief Deputy Oil and Gas Supervisor and the Deputy Oil and Gas Supervisor for District 1 under the Department of Petroleum and Gas were removed from the Sun Finance Building, Los Angeles, to the 6th floor of the New Orpheum Building at 846 S. Broadway near 9th street. These offices occupy nearly the entire sixth floor, and are much more commodious and better arranged for efficient operation than our former quarters. There is also a more convenient and ample space for the oil-field peg models, which will allow for future expansion.

New Publications.

During the quarterly period covered by this issue, the following Bureau publications have been made available for distribution:

Mining in California (quarterly), January, 1926, being Chapter 1 of State Mineralogist's Report XXII. Price 25 cents.

Summary of Operations, California Oil Fields: Vol. 11, Nos. 5, 6 and 7, November and December, 1925, and January, 1926, respectively.

Commercial Mineral Notes: Nos. 35, 36, 37, February-March (inc.). These 'notes' carry the lists of 'mineral deposits wanted' and 'minerals for sale,' issued in the form of a mimeographed sheet, monthly. It is mailed free of charge to those on the mailing list for 'Mining in California.'

Mails and Files.

The Bureau maintains in addition to its correspondence file and the library, a mine report file which includes reports on some 7500 mines and mineral properties in California.

During the period covered by this quarterly report, there were 6280 letters received and answered at the San Francisco office alone, covering almost every phase of prospecting, mining and developing mineral deposits, reduction problems, and marketing of refined products.

DIVISION OF MINERALS AND STATISTICS.

Statistics, Museum, Laboratory.

WALTER W. BRADLEY, Deputy State Mineralogist.

STATISTICS.

California continues to produce commercially, as for some years past, more than fifty different mineral substances (the number reached a total of 60 in 1924), the total annual value of which for 1925, as shown in the January issue of MINING IN CALIFORNIA (see page 109, *ante*) was estimated at \$422,974,500.

At the present writing (May 1st.), reports are in hand from most of the producers. Data for several substances are now complete and have been compiled, being presented herewith.

Information at hand indicates that there was no production in California during 1925 of the following substances, which have at one time or other in the past been on the active list here: Arsenic, barytes, bismuth, cadmium, fluor spar, graphite, lithia, mica, molybdenum, serpentine, slate, strontium, sulphur, and tin. There was production by a single operator in each, of the following: Andalusite, antimony, asbestos, bituminous rock, calcium chloride, and cyanite, the figures for which will have to be combined under the 'unapportioned' item in the final report. The shipments of cyanite were the first in commercial quantity, of record in California. In addition to the above, there are potential deposits of ores of the following which have not as yet yielded a commercial output: Aluminum, cobalt, nickel, and vanadium.

BORATES.

During 1925 there was produced in California a total of 79,865 tons of borate materials compared with 93,273 tons for the year 1924. The materials shipped in 1925 included crude and selected colemanite ore from Inyo and Kern counties varying from 19% to 30% anhydrous boric acid ('A.B.A'), also crystallized borax prepared by evaporation of brines at Searles Lake in San Bernardino County.

As the crude ore is not sold as such, but is almost entirely calcined before shipping to the refinery for conversion into the borax of commerce, and because of the fact that the material varied widely in boric acid content, we have recalculated the tonnage to a basis of 40% A.B.A. This is approximately the average A.B.A. content of the colemanite material after calcining, and also of the crystallized borax obtained from evaporation of the lake brines.

Re-calculated as above, the 1925 production totals 46,124 tons valued at \$1,526,938, a decrease from the similar figures for 1924 which were 52,070 tons and \$1,599,149.

CEMENT.

Cement is the most important single structural material in the mineral output of this state. During 1925, there was produced a total of 13,206,630 barrels, valued at \$25,043,335 f.o.b. plant. This is an increase of 1,551,499 barrels over the record figure of 11,655,131 barrels in 1924, and an increase of \$1,817,530 over the 1924 value of \$23,225,850, but still a little short of the record value of \$25,999,203 in 1923.

The market in 1925 recovered to some extent from the effect of foreign importations duty-free, which caused the drop in 1924, but the effect had not wholly disappeared.

The 1925 output came from ten operating plants in eight counties, and employing a total of 3166 men. The three plants in San Bernardino County made a total of 5,079,281 barrels valued at \$8,828,044, the balance of the state's product coming from a single plant in each of the following counties: Contra Costa, Kern, Riverside, San Benito, San Mateo, Santa Cruz, and Solano. The new plant of the Pacific Portland Cement Company at Redwood City, San Mateo County, began commercial production in 1925. For 1926, the plant of the Calaveras Cement Company has just been completed near San Andreas, Calaveras County, and is now ready to join the producing list.

CHROMITE.

Chromic iron ore, or chromite, to the amount of 591 short tons, recalculated to a basis of 45% Cr_2O_3 , valued at \$10,912 f.o.b. shipping point, was sold in California during the year 1925. This was largely of ore that had been mined during the World War period but not then sold. It is hoped that the development of the steel industry and the resumption of copper smelting on the Pacific Coast may create some demand for California's chromite, but the outlook for the immediate future is not encouraging.

With reference to the War Minerals Relief bills and their administration in which the chromite producers are particularly interested, under the Shortridge amendment of 1921 and under indirect or published stimulation as distinguished from direct personal demand, there has been paid to claimants principally in western states more than five million dollars; while under the act of March 2, 1919, which has been so construed as to limit recoveries to losses induced by direct personal demand, there has been paid about two million. Certain rejected losses now being litigated are principally in claims under the original act, though there are many claimants qualified under the Shortridge amendment who will be entitled to relief in the event the litigation is favorable to the claimants, or in the event further pending legislation (Oddie's Senate Bill 3641) is enacted.

COAL.

Coal production in California in 1925 totaled 730 short tons valued at \$3,880, being credited to Amador, Mendocino, and Riverside counties. Only a small part of it was marketed, as it was mainly consumed for local camp purposes and for power and forge use in development work on the deposits. Considerable development work is under way in Shasta County, as well as in Mendocino. Experiments on a commercial scale are being made by the Pacific Gas and Electric Company with a new type of generator to produce gas from Californian coal at their Marysville gas plant.

DOLOMITE.

The production of dolomite for the year 1925 totaled 42,852 tons valued at \$104,900, being an increase in both quantity and value over the 1924 figures of 28,843 tons and \$81,271, though less than the record

yield of 1923. The 1925 output came from two quarries in Inyo County and one each in San Benito and Tuolumne. The material shipped was utilized for steel-furnace flux and refractories, for manufacture of CO_2 , burned dolomitic lime, for stucco dash-coat, and terrazzo.

FULLER'S EARTH.

The production of 5280 tons valued at \$91,842 here credited to 1925 as 'fuller's earth' is in reality colloidal clay of the montmorillonite class (sold under such local names as 'bentonite,' 'otaylite,' 'shoshonite,' derived from the locality where found). Because of its being utilized for clarifying, filtering, and cleanser purposes, most of it in petroleum refining, we have placed it for the purpose of the State Mining Bureau's statistical reports, under the fuller's earth heading.

After all, the practical test of a fuller's earth is not so much chemical, as a physical one; that is its physical capacity to absorb basic colors and to remove these colors from solution in animal, vegetable, or mineral oils, also from water.

The 1925 output above noted is a slight decrease in amount from the 5290 tons but an increase in value over the figure of \$67,295 in 1924.

GYPSUM.

During 1925, one operator in Imperial County and three in Riverside produced a total of 107,613 tons of gypsum, valued at \$172,444, compared with 25,569 tons and \$53,210 in 1924 and 86,410 tons worth \$188,336 in 1923. The material was utilized mainly in cement manufacture as a retardant, for hard-wall plaster (including wall board), and for fertilizer. The increase over the 1924 figures is due mainly to the larger scale of operations of the Pacific Portland Cement Company's gypsum plant in western Imperial County.

MAGNESITE.

The production of magnesite in California during 1925 amounted to a total of 64,623 tons of crude ore valued at \$872,944. Only a small part of it was sold 'crude,' however, as it is practically all shipped in the calcined form. The reports at hand show a total of 28,110 tons shipped calcined, of which 3726 tons was dead-burned and sold for refractory purposes, the balance going to the plastic trade. From 2 to $2\frac{1}{2}$ tons of crude material are mined to make one ton of calcined. The 1925 output is a slight decrease both in quantity and value from the 1924 figures of 67,236 tons crude valued at \$900,193. The average of the values reported for 1925 is \$13.50 per ton compared with \$13.40 in 1924.

The more important producing properties in 1925 were: Maltby No. 1 (Western Magnesite Development Co., operated under lease of C. S. Maltby) on Red Mountain, Santa Clara County; and the Sierra Magnesite Company's group near Porterville, Tulare County; followed in order, by the Sampson Peak Mine (Maltby No. 3), San Benito County; and California Magnesia Company (old Harker Mine) at Porterville. A small amount was also contributed from Stanislaus County.

A preliminary press bulletin by Mr. J. M. Hill of the U. S. Bureau of Mines (Mar. 1, 1926) shows: Imports of magnesite in 1925 were

4429 tons crude, valued at \$54,593, most of which came from Italy, 17,102 tons of caustic calcined, valued at \$414,734, over half of which came from India, and 47,613 tons of dead-burned, valued at \$703,074, practically all of which was from Italy. This was the equivalent of a total of 143,440 tons of crude ore.

MAGNESIUM SALTS.

The production of magnesium chloride and sulphate in California during 1925 totaled 4221 tons valued at \$132,553, a slight decrease both in quantity and value from the 1924 figures of 4823 tons and \$145,883. This was nearly all chloride, sold for use in magnesite stucco and cement mixtures (Sorel cement), also some for 'road liquor.' It was in part marketed in the liquid form testing 34°-36° Baume, and in part as dry crystals, and was prepared from residual bitterns at salt plants in Alameda, Los Angeles, San Diego, and San Mateo counties. The sulphate marketed was utilized for medicinal and bath purposes.

With the use of magnesite cement and stucco coming more into prominence in building construction on the Pacific Coast, the demand for magnesium chloride is increasing here; but the domestic article has to meet the competition of the cheaper, imported German chloride.

The average value reported for the chloride produced in California in 1925 was approximately \$32 per ton, f.o.b. plant.

MANGANESE.

Manganese ore shipments in California in 1925 amounted to a total of 532 tons of all grades valued at \$11,500, being a decrease both in quantity and value from the 1924 yield which totaled 1115 tons and \$25,785 value. These ores showed analyses of from 45% to 55% Mn, and were utilized by Pacific Coast plants for ferro-manganese.

MINERAL PAINT.

Mineral paint materials were produced in California in 1925 from properties in Stanislaus County, amounting to 669 tons valued at \$6,969. This is an increase over the 532 tons and \$5,234 of 1924, and was entirely of yellow ochre. Hematite has been shipped from Placer County, and red ochre from Sonoma and Ventura counties in former years.

PLATINUM.

In California platinum is obtained as a by-product from placer operations for gold. The major portion of it comes from the dredges working in Butte, Calaveras, Sacramento, Stanislaus, and Yuba counties, with smaller amounts from the hydraulic and surface-sluicing mines of Del Norte, Humboldt, Shasta, Siskiyou, and Trinity.

The production of platinum-group metals in California for the year 1925 totaled 355 ounces, crude, containing 292 fine ounces, valued at \$39,937. Of this amount, a total of 307 ounces, crude, or 86%, came from the gold dredges. This is a slight increase over the 273 fine ounces worth \$36,452 sold in 1924.

The above-noted total of 292 fine ounces includes 120 fine ounces of iridium, osmiridium, ruthenium, and palladium. Most of the platinum

refiners pay for the osmiridium on the basis of its iridium content. Crude 'platinum' is really a mixture of the metals of that group, and carries varying percentages of platinum, iridium, osmiridium or iridosmine, with occasionally some ruthenium and palladium. In addition to the above-noted production, there is usually some platinum recovered as a by-product in the gold refinery of the Mint, but which can not be assigned to the territory of its origin for lack of knowing to which lots of gold it belongs. Some platinum and palladium are also recovered in the electrolytic refining of blister copper.

For 1925, the distribution by counties of California's platinum yield was as follows:

Platinum Production, by Counties, 1925.

County	Fine ounces	Value
Butte -----	^a 56	\$9,177
Shasta -----	8	725
Trinity -----	26	3,081
Calaveras, Del Norte, Humboldt, Sacramento, ^a Siskiyou, Stanislaus, Yuba ^b * -----	202	26,954
Totals -----	292	\$39,937

^a Includes ruthenium and palladium.

^b Includes palladium.

* Combined to conceal output of a single operator in each.

POTASH.

During 1925, a total of 36,355 tons of potash salts of all grades was produced in California valued at \$829,770, compared with 33,107 tons and \$747,407 in 1924. This was entirely of chloride, being mainly from Searles Lake brine, San Bernardino County, but in part from salt-works bitterns at plants in Alameda and San Mateo counties. The quality of the product varied from 45% to 61% equivalent K₂O content; and the material was sold principally for fertilizer manufacture.

PUMICE AND VOLCANIC ASH.

The production of pumice and volcanic ash for the year 1925 amounted to 5319 tons valued at \$32,937, and came from properties in Imperial, Inyo, Kern, and Mono counties. This is an increase in tonnage but slightly lower value compared with the 1924 shipments which were 4919 tons worth \$33,404.

The material from Imperial County and part of that from Mono is of the vesicular, block variety and was sold for abrasive purposes; the balance of the Mono material and that from Inyo and Kern was the volcanic ash, or tuff variety, and was employed in making soap and cleanser compounds. The Kern County ash is going into the preparation of one of the popular and nationally advertised brands of cleanser compounds.

PYRITES.

A total production of 129,500 short tons of pyrites, valued at \$528,-550, was reported shipped in California during 1925 from properties in Alameda, Mariposa, and Shasta counties. This was a slight increase both in tonnage and value over the figures of 124,214 tons and \$517,835 in 1924.

The material was mostly used in the manufacture of sulphuric acid for explosives and fertilizers, but a portion was utilized directly in the preparation of agricultural fertilizer and insecticide. The sulphur content ranged up to 46.5% S.

QUICKSILVER.

Quicksilver was produced in California in seven counties during 1925 to the amount of 7683 flasks (of 75 pounds, avoirdupois) valued at \$621,831, being a slight decrease in quantity but an increase in value compared with the 1924 output of 7948 flasks worth \$543,080. This was due to improved prices. The average price received during 1925, according to the producers' reports to the State Mining Bureau, was \$80.81 per flask, as against \$68.33 in 1924 and the record average of \$114.03 for the year 1918.

The average of San Francisco quotations for 1925 was \$82.60 per flask, the price ranging without sharp fluctuations between \$79.90 and \$82.83 from Jan. 1st until the end of October. Beginning with November the quotations advanced sharply to \$85.17 and to a maximum of \$91.67, closing the year at \$90.17. Thus far for 1926, San Francisco quotations have ranged between \$88 and \$90 per flask. The average of quotations for 1925 in New York was \$83.13 per flask.

The above-noted yield of 7683 flasks in 1925 was won from a total of 59,797 tons of ore, being an average content of 9.64 pounds per ton, or 0.482% mercury.

The U. S. Bureau of Mines reports the total production of the United States for 1925 at 9174 flasks valued at \$762,616 (using the \$83,128 average of New York quotations). Outside of California, the principal yield was from Texas, with a few flasks from Nevada, Arizona, and Idaho. California's contribution was 84% of the total.

The imports of quicksilver in 1925 amounted to 11,245 flasks from Italy and 9754 flasks from Spain, and from all other countries 1782 flasks, making a total of 22,781 flasks. The exports were 204 flasks.

The 1925 quicksilver production in California was distributed by counties, as follows:

County	Flasks	Value
San Benito -----	6,085	\$486,797
Sonoma -----	351	29,134
Kings, Monterey, Napa, San Luis Obispo, Santa Clara* -----	1,247	105,900
Totals -----	7,683	\$621,831

* Combined to conceal output of a single operator in each.

MUSEUM.

The Museum of the State Mining Bureau possesses an exceptionally fine collection of rocks and minerals of both economic and academic value. It ranks among the first five of such collections in North America; and contains not only specimens of most of the known minerals found in California, but much valuable and interesting material from other states and foreign countries as well.

Mineral specimens suitable for exhibit purposes are solicited, and their donation will be appreciated by the State Mining Bureau as well as by those who utilize the facilities of the collection.

The exhibit is daily visited by engineers, students, business men, and prospectors as well as tourists and mere sightseers. Besides its practical use in the economic development of California's mineral resources, the collection is a most valuable educational asset to the state and to San Francisco.

LABORATORY.

FRANK SANBORN, Mineral Technologist.

Comparatively recent research work in the ceramic industries has increased the demand for andalusite, and now the aluminum silicate dumortierite until lately regarded as a mineral of no commercial importance, has come to the front as one having great promises in the ceramic field. When free from certain impurities, dumortierite burns to a pure white and may therefore prove to be a desirable mineral for the better grades of porcelain.

The color of dumortierite is usually a shade of blue or violet-red, but turns white when intensely heated. It is a metamorphic mineral usually found in schists and certain gneisses. In California it is known to occur as large boulders on the plains about twenty-five miles from Ogilby, Imperial County. Samples have also come from Riverside, San Diego and Tuolumne counties.

Samples of andalusite are received occasionally at this bureau, and some of these samples are apparently from newly discovered deposits. Andalusite is now known to occur in Mono, San Diego, San Bernardino, Riverside and Kern counties.

During the four-month period covered by this report 1623 samples were received and determined at the laboratory of the State Mining Bureau. This number is an increase over any previous record, and proves that a great interest is being taken in prospecting for minerals.



LIBRARY.

FOREST L. CAMPBELL, Librarian.

In addition to the numerous standard works, authoritative information on many phases of the mining and mineral industry is constantly being issued in the form of reports and bulletins by various government agencies.

The library of the State Mining Bureau contains some five thousand selected volumes on mines, mining and allied subjects, and it is also a repository for reports and bulletins of the technical departments of federal and state governments and of educational institutions, both domestic and foreign.

It is not the dearth of the latter publications, but rather a lack of knowledge of just what has been published and where the reports may be consulted or obtained, that embarrasses the ordinary person seeking specific information.

To assist in making the public acquainted with this valuable source of current technical information, 'Mining in California' contains under this heading a list of all books and official reports and bulletins received, with names of publishers or issuing departments.

Files of all the leading technical journals will be found in the library, and county and state maps, topographical sheets and geological folios. Current copies of local newspapers published in the mining centers of the State are available for reference.

The library and reading room are open to the public during the usual office hours, when the librarian may be freely called upon for all necessary assistance.

OFFICIAL PUBLICATIONS RECEIVED.

Governmental.

U. S. Geological Survey:

- Bulletin 781-B—Geology of the Baxter Basin Gas Field, Sweetwater County, Wyoming. By Julian D. Sears.
- Bulletin 780-C—Platinum near Centennial, Wyoming. By F. L. Hess.
- Water Supply Paper 563—Ohio River Basin.
- Water Supply Paper 567—Lower Mississippi River Basin.
- Water Supply Paper 542—South Atlantic Slope and Eastern Gulf of Mexico.
- Water Supply Paper 560—Contributions to the Hydrology of the United States in 1925.
- Water Supply Paper 572—Pacific Basins in Washington and Upper Columbia River Basins.
- Water Supply Paper 552—Pacific Basins in Washington and Upper Columbia River Basin.
- Water Supply Paper 546—Missouri River Basin.
- Professional Paper 146—Mississippian Formations of San Saba County, Texas. By P. V. Roundy, et al.
- Professional Paper 140-A—Geology and Flora of the Latah Formation in Relation to the Lavas of the Columbia Plateau near Spokane, Wash. By J. T. Pardee, Kirk Bryan and F. H. Knowlton.
- Professional Paper 140-C—Pleistocene Plants from North Carolina. By E. H. Berry.
- Professional Paper 140-D—Shore Phases of the Green River Formation in Northern Sweetwater County, Wyoming. By W. H. Bradley.
- Professional Paper 138—Mining in Colorado. By Chas. W. Henderson.
- Professional Paper 140-B—Fossil Proboscidea and Edentata of the San Pedro Valley, Arizona. By James Williams Gidley.

Professional Paper 140-F—Correlation of the Basal Cretaceous Beds of the Southeastern States. By Wythe Cooke.

U. S. Bureau of Mines :

Bulletin 197—Sampling and Examination of Mine Gases and Natural Gas. By G. A. Burrell.

Bulletin 242—Explosion Hazards from the Use of Pulverized Coal at Industrial Plants. By L. D. Tracy.

Bulletin 253—Possibilities for the Commercial Utilization of Peat. By W. W. Odell.

Technical Paper 347—Analyses of Alabama Coals. By Chas. Butts.

Mineral Resources of the United States :

Mica in 1924.

Lead in 1924.

Secondary Metals in 1924.

Lead and Zinc Pigments and Salts in 1924.

Asphalt and Related Bitumens in 1924.

Silver, Copper, Lead and Zinc in the Central States in 1924.

Manganese and Manganiferous Ores in 1924.

Reports of Investigations :

Serial No. 2724—The Disposal of Petroleum Foots Oil. By L. G. Marsh and L. D. Wyant.

Serial No. 2725—Stream Pollution by Acid Mine Drainage. By R. D. Leitch.

Serial No. 2726—Coal-Mining Royalties and Leasing Conditions in Williamson and Franklin Counties, Illinois (District No. VI). By L. D. Tracy.

Serial No. 2727—Boiler Water Conditioning with Special Reference to High Operating Pressure and Corrosion. By Dr. R. E. Hall.

Serial No. 2728—Explosives Used in December, 1925, Including Preliminary Figures for the Year 1925. By W. W. Adams.

Serial No. 2729—Coal-Mine Fatalities in January, 1926. By W. W. Adams.

Serial No. 2730—Experiences With the Combustion of Fuel Oil in Power Plant Boilers. By J. F. Barkley.

Serial No. 2731—Analysis of Copper-Palladium-Gold-Silver Concentrates. By C. W. Davis.

Serial No. 2732—Solubility and Effects of Natural Gas and Air in Crude Oils. By D. B. Dow and L. P. Calkin.

Serial No. 2733—Compensation Insurance Rates as a Measurement of Accident Prevention in Mines. By Byron O. Pickard.

Serial No. 2734—(Withdrawn).

Serial No. 2735—The Value of Leakage Tests in Natural-Gas Transmission Lines. By E. L. Rawlins.

Serial No. 2736—Consumption of Explosives in January, 1926. By W. W. Adams.

Serial No. 2737—Additions, Removals and Changes in Permissible List of Explosives from January 1, 1925, to December 31, 1925. By G. St. J. Perrott.

Serial No. 2738—Fatalities in the California Petroleum Industry During the Calendar Year, 1924. By H. C. Miller.

Serial No. 2739—Gases from Blasting in Heavy Sulphides. By E. D. Gardner, G. W. Jones, and J. D. Sullivan.

Serial No. 2740—Thirteenth Semi-Annual Motor Gasoline Survey. By E. C. Lane, H. M. Thorne, and John Devine.

Serial No. 2741—Consumption of Explosives in February, 1926. By W. W. Adams.

Serial No. 2742—Coal-Mine Fatalities in February, 1926. By W. W. Adams.

Information Circulars :

Circular No. 6002—Progress in Use of 1-Inch Steel in the Tri-State Lead and Zinc District. By C. R. Forbes.

Circular No. 6003—The Gasoline Situation. By H. H. Hill.

Arizona Bureau of Mines :

Bulletin 119—A Résumé of Arizona Geology. By N. H. Darton.

Bulletin 121—Field Tests for the Common Metals. By G. R. Fansett.

Georgia Geological Survey: Bulletin 23—Mineral Resources of Georgia. By S. W. McCallie.

Kentucky Geological Survey: Ser. VI, Vol. 27—Mineralogy of Kentucky. By C. H. Richardson.

Nebraska State Museum: Bulletin 10, Vol. 1—Skeletal Parts of the Columbian Mammoth *Elephas Maibeni*. By E. H. Barbour.

North Carolina Geological and Economic Survey:

Bulletin 29—The Kaolins of North Carolina. By W. S. Bailey.

Bulletin 31—Deposits of Brown Iron Ores in Western North Carolina. By W. S. Bailey.

Bulletin 34—Discharge Records of North Carolina Streams. By Thorndike Saville.

Tennessee Division of Geology: Bulletin 34—Water Resources of Tennessee. By W. R. King.

Canada Department of Mines:

Report of the Department of Mines for the Year ending March 31, 1925.

Mines Branch No. 592—Molybdenum, Its Metallurgy and Uses. By V. L. Eardley-Wilmot.

Investigations in Ceramics and Road Materials.

England Geological Survey: The Water Supply of Wiltshire. By W. Whitaker.

Great Britain Geological Survey: The Concealed Coalfield of Yorkshire and Nottinghamshire. By G. V. Wilson.

Geology of Berwick on Tweed.

The Geology of the Country around Stoke-on-Trent.

Mexico Departamento de la Estadística Nacional: La Riqueza de México y El Poder Constructor del Gobierno.

Montevideo, Museo de Historia Natural de: Anales Serie II—Tomo II.

Ontario Department of Mines:

34th Annual Report, 1925.

Part 3.

Part 4.

Part 6.

32nd Annual Report, 1923

Parts 1 to 4.

Parts 5 to 7.

Scotland Geological Survey: The Geology of Strath Oykell and Lower Loch Shin.

South Australia Department of Mines: No. 42—Mining Review for the half year ended June 30, 1925.

Royal Society: Transactions and Proceedings. Vol. XLVIII.

Woods and Forests Department: Annual Progress Report upon State Forest Administration in South Australia for the Year 1924-25.

Societies and Educational Institutions.

University of California: Vol. 16, No. 2—New Canid and Rhinocertid Remains from the Ricardo Pliocene of the Mohave Desert, California. By Chester Stock and E. L. Furlong.

Columbia University: Summer Session Announcement for 1926.

Imperial University of Tokyo, Japan: Journal of the Faculty of Science. Vol. 1,

Parts 3 and 4—Geology, Mineralogy, Geography and Seismology.

University of Missouri, School of Mines and Metallurgy: Vol. 9, No. 1—Engineering and Research. By Milo S. Ketchum.

Academy of Natural Sciences, The, Philadelphia: Proceedings, Vol. LXXVII, 1925.

American Philosophical Society: Vol. LXIV, No. 3, 1925.

Mining and Metallurgical Society of America: Bulletin 182.

Books.

The Engineering Index for 1925.

Maps.

Artesia, Calif.	Meadville, Pa.
Blacksville, W. Va.-Pa.	Memphremagog, Vt.
Bramwell, W. Va.-Va.	Raisin, Calif.
Caruthers, Calif.	Rocky Hill, Calif.
Clarksburg, W. Va.	Schrag, Wash.
Clarksdale, Mo.	Stayton, Ore.
Helm, Calif.	Tulare, Calif.
Indian Head, Md.-Va.	Walton, N. Y.
Ivanhoe, Calif.	West Columbus, Ohio.
Kahului, H. T.	Whittier, Calif.
Long Beach, Calif.	Wilmington, Calif.
Marion, Ill.	

Current Magazines on File.

For the convenience of persons wishing to consult the technical magazines in the reading room, a list of those on file is appended:

American Petroleum Institute, New York.
 Architect and Engineer, San Francisco.
 Arizona Mining Journal, Phoenix, Arizona.
 Asbestos, Philadelphia, Pennsylvania.
 Brick and Clay Record, Chicago.
 Bulletin, Union Oil Co., Los Angeles.
 California Journal of Development, San Francisco.
 Cement, Mill and Quarry, Chicago, Illinois.
 Chemical-Engineering and Mining Review, Melbourne, Australia.
 Engineering and Mining Journal-Press, New York.
 Explosives Engineer, Wilmington, Del.
 Financial Insurance News, Los Angeles, California.
 Graphite, Jersey City.
 Journal of Electricity and Western Industry, San Francisco.
 Metallurgical and Chemical Engineering, New York.
 Mine and Quarry, Chicago.
 Mining and Engineering Record, Vancouver, B. C.
 Mining and Oil Bulletin, Los Angeles.
 Oil Age, Los Angeles.
 Oil and Gas Journal, Tulsa, Oklahoma.
 Oil and Gas News, Kansas City.
 Oil News, Galesburg, Illinois.
 Oildom, New York.
 Oil, Paint and Drug Reporter, New York.
 Oil Trade Journal, New York.
 Oil Weekly, Houston, Texas.
 Petroleum Age, New York.
 Petroleum Record, Los Angeles.
 Petroleum World, Los Angeles.
 Queensland Government Mining Journal, Brisbane, Australia.
 Rock Products, Chicago, Illinois.
 Safety News, Industrial Accident Commission, San Francisco.
 Salt Lake Mining Review, Salt Lake City, Utah.
 Southwest Builder and Contractor, Los Angeles.
 Standard Oil Bulletin, San Francisco.
 Stone, New York.
 The Record, Associated Oil Company, San Francisco.
 Through the Ages, Baltimore.

Newspapers.

The following papers are received and kept on file in the library:

Amador Dispatch, Jackson, Cal.
Arkansas Oil and Mineral News, Hot Springs National Park (Arkansas).
Barstow Printer, Barstow, Cal.
Blythe Herald, Blythe, Cal.
Bridgeport Chronicle-Union, Bridgeport, Mono Co., Cal.
Calaveras Prospect, San Andreas, Cal.
California Oil World, Los Angeles, Cal.
Cloverdale Reveille, Cloverdale, Cal.
Colusa Daily Sun, Colusa, Cal.
Daily Commercial News, San Francisco, Cal.
Daily Midway Driller, Taft, Cal.
Del Norte Triplicate, Crescent City, Cal.
Exeter Sun, Exeter, Cal.
Gateway Gazette, Beaumont, Cal.
Goldfield News, Goldfield, Nevada.
Guerneville Times, Guerneville, Cal.
Healdsburg Enterprise, Healdsburg, Cal.
Humboldt Standard, Eureka, Cal.
Inyo Independent, Independence, Cal.
Inyo Register, Bishop, Cal.
Ione Valley Echo, Ione, Cal.
Lake County Bee, Lakeport, Cal.
Mining and Financial Record, Denver, Colo.
Mining Topics, San Francisco, Cal.
Mountain Democrat, Placerville, Cal.
Mountain Messenger, Downieville, Cal.
Nevada Mining Press, Reno, Nevada.
Oatman Mining News, Oatman, Arizona.
Oregon Observer, Grants Pass, Oregon.
Oroville Daily Register, Oroville, Cal.
Petroleum Reporter, Taft, Cal.
Placer Herald, Auburn, Cal.
Plumas Independent, Quincy, Cal.
Plumas National Bulletin, Quincy, Cal.
Randsburg Times, Randsburg, Cal.
San Diego News, San Diego, Cal.
Shasta Courier, Redding, Cal.
Siskiyou News, Yreka, Cal.
Stockton Record, Stockton, Cal.
Tuolumne Prospector, Tuolumne, Cal.
Ventura Daily Post, Ventura, Cal.
Weekly Trinity Journal, Weaverville, Cal.
Western Sentinel, Etna Mills, Cal.



PRODUCERS AND CONSUMERS.

The producer and consumer of mineral products are mutually dependent upon each other for their prosperity, and one of the most direct aids rendered by the Bureau to the mining industry in the past has been that of bringing producers and consumers into direct touch with each other.

This work has been carried on largely by correspondence, supplemented by personal consultation. Lists of buyers of all the commercial minerals produced in California have been made available to producers upon request, and likewise the owners of undeveloped deposits of various minerals, and producers of them, have been made known to those looking for raw mineral products.

When the publication of MINING IN CALIFORNIA was on a monthly basis, current inquiries from buyers and sellers were summarized and lists of mineral products or deposits 'wanted' or 'for sale' included in each issue.

It is important that inquiries of this nature reach the mining public as soon as possible and in order to avoid the delay incident to the present quarterly publication of MINING IN CALIFORNIA, these lists are now issued monthly in the form of a mimeographed sheet under the title of 'Commercial Mineral Notes.'



EMPLOYMENT SERVICE.

Following the establishment of the Mining Division branch offices in 1919, a free technical employment service was offered as a mutual aid to mine operators and technical men for the general benefit of the mineral industry.

Briefly summarized, men desiring positions are registered, the cards containing an outline of the applicant's qualifications, position wanted, salary desired, etc., and as notices of 'positions open' are received, the names and addresses of all applicants deemed qualified are sent to the prospective employer for direct negotiations.

Telephone and telegraphic communications are also given immediate attention.

The Bureau registers technical men, or those qualified for supervisory positions, and vacancies of like nature, only, as no attempt will be made to supply common mine and mill labor.

A list of current applications for positions and 'positions open' is carried in each issue. Notices are designated by a key number, and the name and address corresponding to any number will be supplied upon request, without delay or charge of any kind. If desired, recommendations may be filed with an application, but copies only should be sent to the Bureau, to avoid possible loss. Registration cards for the use of both prospective employers and employees may be obtained at any office of the Bureau upon request, and a cordial invitation is extended to the industry to make free use of the facilities afforded.

POSITIONS WANTED.

- 41-8 Mine or mill superintendent. Twelve years' experience in west with companies mining copper, lead or zinc and using flotation; can handle either mine or mill. References. Salary open.
- 41-9 Mining. One year's experience as shift boss. Age 28. Single. References. Salary open.
- 41-10 Surveyor. One year with Solano County Surveyor. Age 50. Married. Salary wanted, \$10 per day. References.



PUBLICATIONS OF THE CALIFORNIA STATE MINING BUREAU.

During the past forty-four years, in carrying out the provisions of the organic act creating the California State Mining Bureau, there have been published many reports, bulletins and maps which go to make up a library of detailed information on the mineral industry of the state, a large part of which could not be duplicated from any other source.

One feature that has added to the popularity of the publications is that many of them have been distributed without cost to the public, and even the more elaborate ones have been sold at a price which barely covers the cost of printing.

Owing to the fact that funds for the advancing of the work of this department have often been limited, many of the reports and bulletins mentioned were printed in limited editions which are now entirely exhausted.

Copies of such publications are available, however, in the Bureau's offices in the Ferry Building, San Francisco; New Orpheum Building, Los Angeles; Chamber of Commerce Building, Sacramento; Santa Maria; Santa Paula; Coalinga; Taft; Bakersfield. They may also be found in many public, private and technical libraries in California and other states, and foreign countries.

A catalog of all publications of the Bureau, from 1880 to 1917, giving a synopsis of their contents, is issued as Bulletin No. 77.

Publications in stock may be obtained by addressing any of the offices of the State Mining Bureau and enclosing the requisite amount in the case of publications that have a list price. The Bureau is authorized to receive only coin, stamps or money orders, and it will be appreciated if remittance is made in this manner rather than by personal check.

The prices noted include delivery charges to all parts of the United States. Money orders should be made payable to the State Mining Bureau.

REPORTS.

Asterisks (**) indicate the publication is out of print.

	Price
**First Annual Report of the State Mineralogist, 1880, 43 pp. Henry G. Hanks	-----
**Second Annual Report of the State Mineralogist, 1882, 514 pp., 4 illustrations, 1 map. Henry G. Hanks.....	-----
**Third Annual Report of the State Mineralogist, 1883, 111 pp., 21 illustrations. Henry G. Hanks.....	-----
**Fourth Annual Report of the State Mineralogist, 1884, 410 pp., 7 illustrations. Henry G. Hanks.....	-----
**Fifth Annual Report of the State Mineralogist, 1885, 234 pp., 15 illustrations, 1 geological map. Henry G. Hanks.....	-----
**Sixth Annual Report of the State Mineralogist, Part I, 1886, 145 pp., 3 illustrations, 1 map. Henry G. Hanks.....	-----
**Part II, 1887, 222 pp., 36 illustrations. William Irelan, Jr.....	-----
**Seventh Annual Report of the State Mineralogist, 1887, 315 pp. William Irelan, Jr.	-----
**Eighth Annual Report of the State Mineralogist, 1888, 948 pp., 122 illustrations. William Irelan, Jr.....	-----
**Ninth Annual Report of the State Mineralogist, 1889, 352 pp., 57 illustrations, 2 maps. William Irelan, Jr.....	-----

REPORTS—Continued.

Asterisks (**) indicate the publication is out of print.

	Price
**Tenth Annual Report of the State Mineralogist, 1890, 983 pp., 179 illustrations, 10 maps. William Ireland, Jr.-----	----
Eleventh Report (First Biennial) of the State Mineralogist, for the two years ending September 15, 1892, 612 pp., 73 illustrations, 4 maps. William Ireland, Jr.-----	\$1.00
**Twelfth Report (Second Biennial) of the State Mineralogist, for the two years ending September 15, 1894, 541 pp., 101 illustrations, 5 maps. J. J. Crawford-----	----
**Thirteenth Report (Third Biennial) of the State Mineralogist, for the two years ending September 15, 1896, 726 pp., 93 illustrations, 1 map. J. J. Crawford-----	----
Chapters of the State Mineralogist's Report, Biennial Period, 1913-1914, Fletcher Hamilton:	----
**Mines and Mineral Resources, Amador, Calaveras and Tuolumne Counties, 172 pp., paper-----	----
Mines and Mineral Resources, Colusa, Glenn, Lake, Marin, Napa, Solano, Sonoma and Yolo Counties, 208 pp., paper-----	.50
Mines and Mineral Resources, Del Norte, Humboldt, and Mendocino Counties, 59 pp., paper-----	.25
**Mines and Mineral Resources, Fresno, Kern, Kings, Madera, Mariposa, Merced, San Joaquin and Stanislaus Counties, 220 pages, paper-----	----
Mines and Mineral Resources of Imperial and San Diego Counties, 113 pp., paper-----	.35
**Mines and Mineral Resources, Shasta, Siskiyou and Trinity Counties, 180 pp., paper-----	----
Fourteenth Report of the State Mineralogist, for the Biennial Period 1913-1914, Fletcher Hamilton, 1915:	
A General Report on the Mines and Mineral Resources of Amador, Calaveras, Tuolumne, Colusa, Glenn, Lake, Marin, Napa, Solano, Sonoma, Yolo, Del Norte, Humboldt, Mendocino, Fresno, Kern, Kings, Madera, Mariposa, Merced, San Joaquin, Stanislaus, San Diego, Imperial, Shasta, Siskiyou, and Trinity Counties, 974 pp., 275 illustrations, cloth-----	2.00
Chapters of the State Mineralogist's Report, Biennial Period, 1915-1916, Fletcher Hamilton:	
**Mines and Mineral Resources, Alpine, Inyo and Mono Counties, 176 pp., paper-----	----
Mines and Mineral Resources, Butte, Lassen, Modoc, Sutter and Tehama Counties, 91 pp., paper-----	.50
Mines and Mineral Resources, El Dorado, Placer, Sacramento, and Yuba Counties, 198 pp., paper-----	.65
Mines and Mineral Resources, Monterey, San Benito, San Luis Obispo, Santa Barbara, and Ventura Counties, 183 pp., paper-----	.65
Mines and Mineral Resources, Los Angeles, Orange, and Riverside Counties, 136 pp., paper-----	.50
**Mines and Mineral Resources, San Bernardino and Tulare Counties, 186 pp., paper-----	----
**Fifteenth Report of the State Mineralogist, for the Biennial Period 1915-1916, Fletcher Hamilton, 1917:	
A General Report on the Mines and Mineral Resources of Alpine, Inyo, Mono, Butte, Lassen, Modoc, Sutter, Tehama, Placer, Sacramento, Yuba, Los Angeles, Orange, Riverside, San Benito, San Luis Obispo, Santa Barbara, Ventura, San Bernardino and Tulare Counties, 990 pp., 413 illustrations, cloth-----	----
Chapters of the State Mineralogist's Report, Biennial Period 1917-1918, Fletcher Hamilton:	
Mines and Mineral Resources of Nevada County, 270 pp., paper-----	.75
Mines and Mineral Resources of Plumas County, 188 pp., paper-----	.50
Mines and Mineral Resources of Sierra County, 144 pp., paper-----	.50
Seventeenth Report of the State Mineralogist, 1920, Mining in California during 1920, Fletcher Hamilton; 562 pp., 71 illustrations, cloth-----	1.75

REPORTS—Continued.

Asterisks (**) indicate the publication is out of print.

	Price
Eighteenth Report of the State Mineralogist, 1922, Mining in California, Fletcher Hamilton. Chapters published monthly beginning with January, 1922 :	
**January, **February, March, April, May, June, July, August, September, October, November, December, 1922-----	Free
Chapters of Nineteenth Report of the State Mineralogist, 'Mining in California,' Fletcher Hamilton and Lloyd L. Root. January, February, March, September, 1923-----	Free
Chapters of Twentieth Report of the State Mineralogist, 'Mining in California,' Lloyd L. Root. Published quarterly. January, April, July, October, 1924, per copy-----	\$0.25
Chapters of Twenty-first Report of the State Mineralogist, 'Mining in California,' Lloyd L. Root. Published quarterly.	
January, 1925, Mines and Mineral Resources of Sacramento, Monterey and Orange counties-----	.25
April, 1925, Mines and Mineral Resources of Calaveras, Merced, San Joaquin, Stanislaus and Ventura counties-----	.25
July, 1925, Mines and Mineral Resources of Del Norte, Humboldt and San Diego counties-----	.25
October, 1925, Mines and Mineral Resources of Siskiyou, San Luis Obispo and Santa Barbara counties-----	.25
Subscription, \$1.00 in advance (by calendar year, only).-----	
Chapters of Twenty-second Report of the State Mineralogist, 'Mining in California,' Lloyd L. Root. Published quarterly.	
January, 1926, Mines and Mineral Resources of Trinity and Santa Cruz counties-----	.25
Chapters of State Oil and Gas Supervisor's Report :	
Summary of Operations—California Oil Fields, July, 1918, to March, 1919 (one volume)-----	Free
Summary of Operations—California Oil Fields. Published monthly, beginning April, 1919 :-----	
**April, **May, June, **July, **August, **September, **October, November, **December, 1919-----	Free
January, February, March, April, **May, June, July, **August, September, October, November, December, 1920-----	Free
January, **February, **March, **April, May, June, **July, August, **September, **October, **November, **December, 1921-----	Free
January, February, March, April, May, June, July, August, September, October, November, December, 1922-----	Free
January, February, March, April, May, June, July, August, September, October, November, December, 1923-----	Free
January, February, March, April, May, June, July, August, September, October, November, December, 1924-----	Free
January, February, March, April, May, June, July, August, September, October, 1925-----	Free

BULLETINS.

Asterisks (**) indicate the publication is out of print.

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**Bulletin No. 2. Methods of Mine Timbering, by W. H. Storms. 1894. 58 pp., 75 illustrations-----	----
**Bulletin No. 3. Gas and Petroleum Yielding Formations of Central Valley of California, by W. L. Watts. 1894, 100 pp., 13 illustrations, 4 maps-----	----
**Bulletin No. 4. Catalogue of Californian Fossils, by J. G. Cooper, 1894. 73 pp., 67 illustrations. (Part I was published in the Seventh Annual Report of the State Mineralogist, 1887.)-----	----
**Bulletin No. 5. The Cyanide Process, 1894, by Dr. A. Scheidel. 140 pp., 46 illustrations-----	----

BULLETINS—Continued.

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Bulletin No. 6. California Gold Mill Practices, 1895, by E. B. Preston. 85 pp., 46 illustrations.....	\$0.50
**Bulletin No. 7. Mineral Production of California, by Counties for the year 1894, by Charles G. Yale. Tabulated sheet.....	-----
**Bulletin No. 8. Mineral Production of California, by Counties for the year 1895, by Charles G. Yale. Tabulated sheet.....	-----
**Bulletin No. 9. Mine Drainage, Pumps, etc., by Hans C. Behr. 1896. 210 pp., 206 illustrations.....	-----
**Bulletin No. 10. A bibliography Relating to the Geology, Palæontology and Mineral Resources of California, by Anthony W. Vogdes. 1896, 121 pp.	-----
**Bulletin No. 11. Oil and Gas Yielding Formations of Los Angeles, Ventura and Santa Barbara counties, by W. L. Watts. 1897, 94 pp., 6 maps, 31 illustrations.....	-----
**Bulletin No. 12. Mineral Production of California, by Counties for 1896, by Charles G. Yale. Tabulated sheet.....	-----
**Bulletin No. 13. Mineral Production of California, by Counties for 1897, by Charles G. Yale. Tabulated sheet.....	-----
**Bulletin No. 14. Mineral Production of California, by Counties for 1898, by Charles G. Yale.....	-----
**Bulletin No. 15. Map of Oil City Fields, Fresno County, by John H. Means. 1899.....	-----
**Bulletin No. 16. The Genesis of Petroleum and Asphaltum in California, by A. S. Cooper. 1899, 39 pp., 29 illustrations.....	-----
**Bulletin No. 17. Mineral Production of California, by Counties for 1899, by Charles G. Yale. Tabulated sheet.....	-----
**Bulletin No. 18. Mother Lode Region of California, by W. H. Storms. 1900, 154 pp., 49 illustrations.....	-----
**Bulletin No. 19. Oil and Gas Yielding Formations of California, by W. L. Watts. 1900, 236 pp., 60 illustrations, 8 maps.....	-----
**Bulletin No. 20. Synopsis of General Report of State Mining Bureau, by W. L. Watts. 1901, 21 pp. This bulletin contains a brief statement of the progress of the mineral industry in California for the four years ending December, 1899.....	-----
**Bulletin No. 21. Mineral Production of California by Counties, by Charles G. Yale. 1900. Tabulated sheet.....	-----
**Bulletin No. 22. Mineral Production of California for Fourteen Years, by Charles G. Yale. 1900. Tabulated sheet.....	-----
Bulletin No. 23. The Copper Resources of California, by P. C. DuBois, F. M. Anderson, J. H. Tibbits and G. A. Tweedy. 1902, 282 pp., 69 illustrations, and 9 maps.....	50
**Bulletin No. 24. The Saline Deposits of California, by G. E. Bailey. 1902, 216 pp., 99 illustrations, 5 maps.....	-----
**Bulletin No. 25. Mineral Production of California, by Counties, for 1901, by Charles G. Yale. Tabulated sheet.....	-----
**Bulletin No. 26. Mineral Production of California for the past Fifteen Years, by Charles G. Yale. 1902. Tabulated sheet.....	-----
**Bulletin No. 27. The Quicksilver Resources of California, by William Forstner. 1903, 273 pp., 144 illustrations, 8 maps.....	-----
**Bulletin No. 28. Mineral Production of California, for 1902, by Charles G. Yale. Tabulated sheet.....	-----
**Bulletin No. 29. Mineral Production of California for Sixteen Years, by Charles G. Yale. 1903. Tabulated sheet.....	-----
**Bulletin No. 30. Bibliography Relating to the Geology, Palæontology, and Mineral Resources of California, by A. W. Vogdes. 1903, 290 pp.	-----
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**Bulletin No. 32. Production and Use of Petroleum in California, by Paul W. Prutzman. 1904, 230 pp., 116 illustrations, 14 maps.....	-----
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**Bulletin No. 40. Mineral Production of California for Eighteen Years, by Charles G. Yale. 1905. Tabulated sheet-----	----
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**Bulletin No. 45. Auriferous Black Sands of California, by J. A. Edman. 1907. 10 pp.-----	----
Bulletin No. 46. General Index of Publications of the California State Mining Bureau, by Charles G. Yale. 1907, 54 pp.-----	\$0.30
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**Bulletin No. 68. Mineral Production for 1913, with County Maps and Mining Laws, by E. S. Boalich. 160 pp. -----	-----
**Bulletin No. 69. Petroleum Industry of California, with Folio of Maps (18 by 22), by R. P. McLaughlin and C. A. Waring. 1914, 519 pp., 13 illustrations, 83 figs. [18 plates in accompanying folio.] -----	-----
**Bulletin No. 70. Mineral Production for 1914, with County Maps and Mining Laws. 184 pp. -----	-----
**Bulletin No. 71. Mineral Production for 1915, with County Maps and Mining Laws, by Walter W. Bradley. 193 pp., 4 illustrations. -----	-----
Bulletin No. 72. The Geologic Formations of California, by James Perrin Smith. 1916, 47 pp. -----	\$0.25
Reconnaissance Geologic Map (of which, Bulletin 72 is explanatory), in 23 colors. Scale: 1 inch equals 12 miles. Mounted -----	2.50
**Bulletin No. 73. First Annual Report of the State Oil and Gas Supervisor of California, for the fiscal year 1915-16, by R. P. McLaughlin. 278 pp., 26 illustrations -----	-----
Bulletin No. 74. Mineral Production of California in 1916, with County Maps, by Walter W. Bradley. 179 pp., 12 illustrations. -----	Free
**Bulletin No. 75. United States and California Mining Laws, 1917. 115 pp., paper -----	-----
Bulletin No. 76. Manganese and Chromium in California, by Walter W. Bradley, Emile Huguenin, C. A. Logan, W. B. Tucker and C. A. Waring, 1918. 248 pp., 51 illustrations, 5 maps, paper -----	.50
Bulletin No. 77. Catalogue of Publications of California State Mining Bureau, 1880-1917, by E. S. Boalich. 44 pp., paper -----	Free
Bulletin No. 78. Quicksilver Resources of California, with a Section on Metallurgy and Ore-Dressing, by Walter W. Bradley, 1918. 389 pp., 77 photographs and 42 plates (colored and line cuts), cloth -----	1.50
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Bulletin No. 80. Tungsten, Molybdenum and Vanadium in California. (In preparation.) -----	-----
Bulletin No. 81. Foothill Copper Belt of California. (In preparation.) -----	-----
**Bulletin No. 82. Second Annual Report of the State Oil and Gas Supervisor, for the fiscal year 1916-1917, by R. P. McLaughlin, 1918. 412 pp., 31 illustrations, cloth -----	-----
Bulletin No. 83. California Mineral Production for 1917, with County Maps, by Walter W. Bradley. 179 pp., paper -----	Free
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Bulletin No. 91. Minerals of California, by Arthur S. Eakle, 1923, 328 pp., cloth -----	1.00

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Bulletin No. 96. California Mineral Production for 1924, by Walter W. Bradley, 1925. 173 pp., paper-----	Free
**Preliminary Report No. 1. Notes on Damage by Water in California Oil Fields, December, 1913. By R. P. McLaughlin. 4 pp.-----	----
**Preliminary Report No. 2. Notes on Damage by Water in California Oil Fields, March, 1914. By R. P. McLaughlin. 4 pp.-----	----
Preliminary Report No. 3. Manganese and Chromium, 1917. By E. S. Boalich. 32 pp.-----	----
Preliminary Report No. 4. Tungsten, Molybdenum and Vanadium. By E. S. Boalich and W. O. Castello, 1918. 34 pp. Paper-----	Free
Preliminary Report No. 5. Antimony, Graphite, Nickel, Potash, Strontium and Tin. By E. S. Boalich and W. O. Castello, 1918. 44 pp. Paper-----	Free
**Preliminary Report No. 6. A Review of Mining in California During 1919. Fletcher Hamilton, 1920. 43 pp. Paper-----	----
**Preliminary Report No. 7. The Clay Industry in California. By E. S. Boalich, W. O. Castello, E. Huguenin, C. A. Logan, and W. B. Tucker, 1920. 102 pp. 24 illustrations. Paper-----	----
**Preliminary Report No. 8. A Review of Mining in California During 1921, with Notes on the Outlook for 1922. Fletcher Hamilton, 1922. 68 pp. Paper-----	----

MISCELLANEOUS PUBLICATIONS.

Asterisks (**) indicate the publication is out of print.

**First Annual Catalogue of the State Museum of California, being the collection made by the State Mining Bureau during the year ending April 16, 1881. 350 pp.-----	----
**Catalogue of books, maps, lithographs, photographs, etc., in the library of the State Mining Bureau at San Francisco, May 15, 1884. 19 pp.-----	----
**Catalogue of the State Museum of California, Volume II, being the collection made by the State Mining Bureau from April 16, 1881, to May 5, 1884. 220 pp.-----	----
**Catalogue of the State Museum of California, Volume III, being the collection made by the State Mining Bureau from May 15, 1884, to March 31, 1887. 195 pp.-----	----
**Catalogue of the State Museum of California, Volume IV, being the collection made by the State Mining Bureau from March 30, 1887, to August 20, 1890. 261 pp.-----	----
**Catalogue of the Library of the California State Mining Bureau, September 1, 1892. 149 pp.-----	----
**Catalogue of West North American and Many Foreign Shells with Their Geographical Ranges, by J. G. Cooper. Printed for the State Mining Bureau, April, 1894-----	----
**Report of the Board of Trustees for the four years ending September, 1900. 15 pp. Paper-----	----
Bulletin. Reconnaissance of the Colorado Desert Mining District. By Stephen Bowers, 1901. 19 pp. 2 illustrations. Paper-----	Free
Commercial Mineral Notes. A monthly mimeographed sheet, beginning April, 1923-----	Free

MAPS.

Registers of Mines With Maps.

Asterisks (**) indicate out of print.

	Price
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**Register of Mines, with Map, Butte County -----	-----
**Register of Mines, with Map, Calaveras County -----	-----
**Register of Mines, with Map, El Dorado County -----	-----
**Register of Mines, with Map, Inyo County -----	-----
**Register of Mines, with Map, Kern County -----	-----
**Register of Mines, with Map, Lake County -----	-----
**Register of Mines, with Map, Mariposa County -----	-----
**Register of Mines, with Map, Nevada County -----	-----
**Register of Mines, with Map, Placer County -----	-----
**Register of Mines, with Map, Plumas County -----	-----
**Register of Mines, with Map, San Bernardino County -----	-----
**Register of Mines, with Map, San Diego County -----	-----
Register of Mines, with Map, Santa Barbara County -----	\$0.25
**Register of Mines, with Map, Shasta County -----	-----
**Register of Mines, with Map, Sierra County -----	-----
**Register of Mines, with Map, Siskiyou County -----	-----
**Register of Mines, with Map, Trinity County -----	-----
**Register of Mines, with Map, Tuolumne County -----	-----
Register of Mines, with Map, Yuba County -----	.25
Register of Oil Wells, with Map, Los Angeles City -----	.35

OTHER MAPS.

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**Map of California. Showing Mineral Deposits (50 x 60 in.)—	
Map of Forest Reserves in California—	
Mounted -----	.50
**Unmounted -----	-----
**Mineral and Relief Map of California -----	-----
**Map of El Dorado County, Showing Boundaries, National Forests -----	-----
**Map of Madera County, Showing Boundaries, National Forests -----	-----
**Map of Placer County, Showing Boundaries, National Forests -----	-----
**Map of Shasta County, Showing Boundaries, National Forests -----	-----
**Map of Sierra County, Showing Boundaries, National Forests -----	-----
**Map of Siskiyou County, Showing Boundaries, National Forests -----	-----
**Map of Tuolumne County, Showing Boundaries, National Forests -----	-----
**Map of Mother Lode Region -----	-----
**Map of Desert Region of Southern California -----	-----
Map of Minaret District, Madera County -----	.20
Map of Copper Deposits in California -----	.05
**Map of Calaveras County -----	-----
**Map of Plumas County -----	-----
**Map of Trinity County -----	-----
**Map of Tuolumne County -----	-----
Geological Map of Inyo County. Scale 1 inch equals 4 miles. -----	.60
Map of California accompanying Bulletin No. 89, showing generalized classification of land with regard to oil possibilities. Map only, without Bulletin -----	.25
Geological Map of California, 1916. Scale 1 inch equals 12 miles. As accurate and up-to-date as available data will permit as regards topography and geography. Shows railroads, highways, post offices and other towns. First geological map that has been available since 1892, and shows geology of entire state as no other map does. Geological details lithographed in 23 colors. Mounted -----	2.50
Topographic Map of Sierra Nevada Gold Belt, showing distribution of auriferous gravels. In 4 colors -----	.50

OIL FIELD MAPS.

	Price
These maps are revised from time to time as development work advances and ownerships change.	
Map No. 1—Sargent, Santa Clara County-----	\$0.50
Map No. 2—Santa Maria, including Cat Canyon and Los Alamos-----	.75
Map No. 3—Santa Maria, including Casmalia and Lompoc-----	.75
Map No. 4—Whittier-Fullerton, including Olinda, Brea Canyon, Puente Hills, East Coyote and Richfield-----	.75
Map No. 5—Whittier-Fullerton, including Whittier, West Coyote, and Montebello-----	.75
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Map No. 19—Arroyo Grande, San Luis Obispo County-----	.75
Map No. 20—Long Beach Oil Field-----	1.00
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Map No. 22—Portion of District 3, Showing Oil Fields, Santa Barbara County-----	.75
Map No. 23—Portion of District 2, Showing Boundaries of Oil Fields, Ventura County-----	.75
Map No. 24—Portion of District 1, Showing Boundaries of Oil Fields, Los Angeles and Orange counties-----	.75
Map No. 26—Huntington Beach Oil Field-----	.75
Map No. 27—Santa Fe Springs Oil Field-----	.75
Map No. 28—Torrance, Los Angeles County-----	.75
Map No. 29—Dominguez, Los Angeles County-----	1.00
Map No. 30—Rosecrans, Los Angeles County-----	.75
Map No. 31—Inglewood, Los Angeles County-----	.75

DETERMINATION OF MINERAL SAMPLES.

Samples (limited to three at one time) of any mineral found in the state may be sent to the Bureau for identification, and the same will be classified free of charge. No samples will be determined if received from points outside the state. It must be understood that no assays, or quantitative determinations will be made. Samples should be in lump form if possible, and marked plainly with name of sender on outside of package, etc. No samples will be received unless delivery charges are prepaid. A letter should accompany sample, giving locality where mineral was found and the nature of the information desired.

THE STATE MINING BUREAU
CORDIALLY INVITES YOU TO VISIT
ITS VARIOUS DEPARTMENTS MAINTAINED
FOR THE PURPOSE OF FURTHERING
THE DEVELOPMENT OF THE
MINERAL RESOURCES OF CALI-
FORNIA

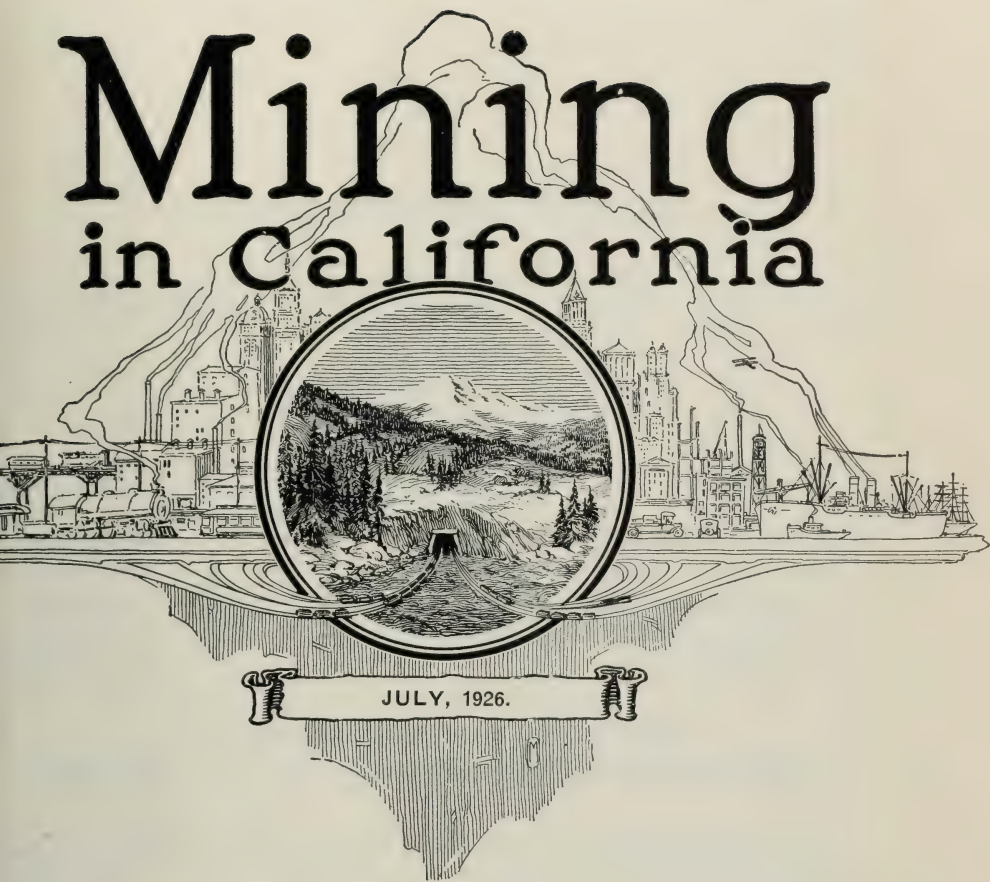
At the service of the public are the scientific reference library and reading room, the general information bureau, the laboratory for the free determination of mineral samples found in the state, and the largest museum of mineral specimens on the Pacific Coast. The time and attention of the state mineralogist, as well as that of his technical staff, are also at your disposal.

Office hours: 9 a.m. to 5 p.m. daily
Saturday, 9 a.m. to 12 m.

Lloyd L. Root,
State Mineralogist.

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Branch Offices: New Orpheum Building, Los Angeles; Chamber of Commerce Building (mail address, P. O. Box 1208), Sacramento; Bank of Italy Building, Bakersfield; Taft, Coalinga, Santa Maria, and Santa Paula.

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DEPARTMENT OF PETROLEUM AND GAS

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NOTE.—A detailed report of the activities of the Department of Petroleum and Gas is issued monthly by the State Mining Bureau, entitled 'Summary of Operations, California Oil Fields.'

CALIFORNIA STATE MINING BUREAU

FERRY BUILDING, SAN FRANCISCO

LLOYD L. ROOT

State Mineralogist

Vol. 22

JULY, 1926

No. 3

CHAPTER OF

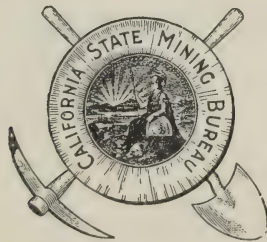
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COVERING

MINING IN CALIFORNIA

AND THE

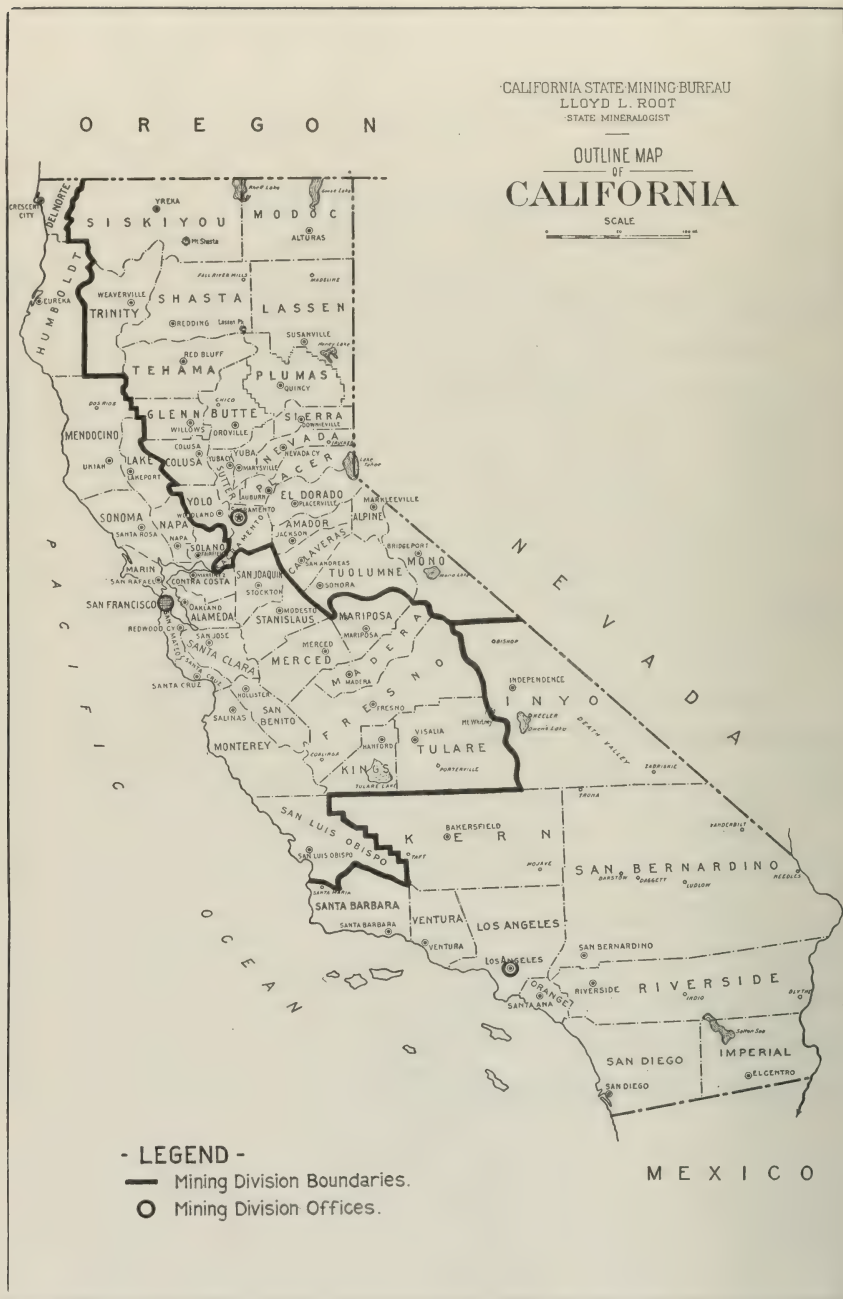
ACTIVITIES OF THE STATE MINING BUREAU



CALIFORNIA STATE PRINTING OFFICE
JOHN E. KING, State Printer
SACRAMENTO, 1926

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PREFACE.

The State Mining Bureau is maintained for the purpose of assisting in all possible ways in the development of California's mineral resources.

As one means of offering tangible service to the mining public, the State Mineralogist for many years has issued an annual or a biennial report reviewing in detail the mines and mineral deposits of the various counties.

The weak point in work of this character has been that the results of field investigations were so long in preparation that they had lost much of their usefulness by the time they finally appeared in print.

As a progressive step in advancing the interests of the mineral industry, publication of the Annual Report of the State Mineralogist in the form of monthly chapters was begun in January, 1922, and continued until March, 1923.

Owing to a lack of funds for printing, quarterly publication was begun in September, 1923.

For the same reason, beginning with the January, 1924, issue, it has been necessary to charge a subscription price of \$1 per calendar year, payable in advance; single copies, 25 cents apiece. 'Mining in California' will continue to be sent without charge to our exchange list, including schools and public libraries, as are also other publications of the State Mining Bureau.

Pages are numbered consecutively throughout the year and an index to the complete reports is included annually in the closing number.

Such a publication admits of several improvements over the old method of procedure. Each issue contains a report of the current development and mining activities of the state, prepared by the district mining engineers. Special articles dealing with various phases of mining and allied subjects by members of the staff and other contributors are included. Mineral production reports formerly issued only as an annual statistical bulletin are published herein as soon as returns from producers are compiled. The executive activities, and those of the laboratory, museum, library, employment service and other features with which the public has had too little acquaintance also are reported.

While current activities of all descriptions will be covered in these chapters, the Bureau will not discontinue its practice of issuing from time to time technical reports on special subjects. A list of such reports now available is appended hereto, and the names of new bulletins will be added in the future as they are completed.

The chapters will be subject to revision, correction and improvement. Constructive suggestions from the mining public will be gladly received, and are invited.

The one aim of the Mining Bureau is to increase its usefulness and to stimulate the intelligent development of the wonderful, latent resources of the State of California.

DISTRICT REPORTS OF MINING ENGINEERS.

In 1919-1920 the Mining Department was organized into four main geographical divisions, with the field work delegated to a mining engineer in each district working out from field offices that were established in Redding, Auburn, San Francisco and Los Angeles, respectively.

This move brought the Bureau into closer personal contact with operators, and it has many advantages over former methods of conducting field work.

To continue this system most effectively with the limited funds available for the present biennium, the Redding and Auburn field offices were consolidated and moved to Sacramento on June 1, 1923.

The boundaries of each district were adjusted and the counties now included in each of the three divisions, and the locations of the branch offices, are shown on the accompanying outline map of the state. (Frontispiece.)

Reports of mining activities and development in each division, prepared by the district engineer, will continue to appear under the proper field division heading.

Although the petroleum industry is but little affiliated with other branches of mining, oil and gas are among the most valuable mineral products of California, and a report by the State Oil and Gas Supervisor on the current development and general conditions in the state's oil fields is included under this heading.

New County Reports.

The series of separate reports on the mines and mineral resources of the different counties, that together comprise the State Mineralogist's Reports XIV to XVII, inclusive, in the case of many of the counties have become exhausted. Those still in stock are in need of revision. It has been thought advisable, therefore, beginning with the January, 1925, issue of 'Mining in California,' to make the district engineers' reports in the form of a complete general report on the mines and mineral resources in one or more of the counties in each district.

This program will be followed as near as possible in succeeding numbers of the quarterly until each county in the state has been covered.

SACRAMENTO FIELD DIVISION.

C. A. LOGAN, Mining Engineer.

On account of unfinished field work, there is no report from the Sacramento Division in this issue.

SAN FRANCISCO FIELD DIVISION.

C. MCK. LAIZURE, Mining Engineer.

MARIN COUNTY

Introduction.

Marin is one of the original twenty-seven counties into which the State was divided at the first session of the legislature in 1850. In comparison with most of the other twenty-six original counties, its area was very small. In the intervening years there has been practically no change in its land area, but changes in its southern boundary have slightly increased its water area, and it now comprises a total of 529 square miles. Angel Island and Belvedere Island are a part of Marin County. Its population is 27,342 (1920 census).

Geography and Topography.

Marin County lies north of San Francisco, the Marin Peninsula and San Francisco Peninsula being separated by the Golden Gate. The Pacific Ocean bounds it on the west, Sonoma County and portions of San Pablo Bay and San Francisco Bay surround it on the north and east.

The main line of the Northwestern Pacific railroad runs through the eastern side of the county, and a narrow gauge branch traverses the western portion, passing through Point Reyes and continuing northward into Sonoma County.

Marin County is for the most part rugged and picturesque, the ridges having steep slopes with only a few small flat valleys. The main ridge trends northwesterly, culminating at the south in Mount Tamalpais, which overlooks both bay and ocean from an elevation of 2601 feet. From this main crest the drainage is both to the ocean and bay sides. Other notable topographic features are Tomales, Drakes, Bodega and Bolinas bays on the ocean side and Richardsons Bay on the inland side.

Geology.

The geology of the Marin Peninsula has been described by Lawson¹ and Osmont², to which the reader is referred for a detailed discussion.

Geologically, the county is divided into two areas by the great San Andreas fault, which runs in a northwest direction from Bolinas Bay to Tomales Bay. The country lying east of the fault comprises about three-fourths of the county and is composed almost entirely of Franciscan rocks. These include massive sandstone, chert and intrusive bodies of serpentine and basalt. The Point Reyes Peninsula, which includes that portion of the county lying west of San Andreas Fault, is composed mainly of Monterey shale, which is distinctly bituminous in places. Two small areas of volcanic rock are exposed near Inverness and Tomales Point.

Mineral Resources.

The mineralization of the county is diversified but the deposits that may be classed as economic resources are limited, though important on account of their proximity to the metropolitan bay area. The economic minerals are mainly structural and industrial non-metallic products.

¹ Lawson, A. C., U. S. Geol. Survey, San Francisco, Folio No. 193.

² Osmont, V. C., Bull. Dept. of Geology, University of California, Vol. 4, No. 3.

Occurrences have also been noted of asphaltum, petroleum, chromite, coal, jasper, garnets, manganese, mineral water, and natural gas. A little copper ore was at one time shipped, and traces of gold and silver have been found. Salt has been produced.

At the present time, brick and clay, crushed rock and mineral water are the commercial products. The total recorded mineral production from 1888 to 1925, inclusive, approximates \$7,750,000 in value. In 1925 the county's output was valued at \$434,802, and the county ranked thirty-fourth in the state. The accompanying table shows the total recorded production from 1888 to 1925, inclusive.

MARIN COUNTY,

Year	Brick		Miscellaneous stone ¹	
	M.	Value	Tons	Value
1888	1,600	\$10,000		
1889	*2,000	12,000		
1890	*5,000	30,000		
1891	*10,000	60,000		
1892	*12,000	72,000		
1893	18,000	108,000		
1894	28,500	172,500		\$16,850
1895	29,000	145,000		7,790
1896	15,000	85,000	7,849	8,260
1897	15,000	89,000	6,000	7,200
1898	15,500	66,000	1,710	1,800
1899	16,500	76,000	4,400	5,150
1900	25,000	200,000	3,000	2,500
1901	14,320	100,240	34,000	27,987
1902	14,600	97,700	149,450	105,350
1903	13,819	78,095	144,715	140,332
1904	20,500	132,000	216,576	170,995
1905	22,877	163,585	113,000	44,250
1906	23,900	199,300	54,000	53,000
1907	16,000	118,000	157,100	134,111
1908	10,000	50,000	111,686	66,700
1909	4,500	105,000	132,010	67,010
1910	22,497	99,185	112,000	74,700
1911	19,695	87,445	173,646	108,786
1912	18,000	88,200	5,300	3,000
1913	16,000	70,500	428,357	198,953
1914	15,000	55,000		490,137
1915	10,000	50,000		101,528
1916	2			74,000
1917	2			158,582
1918	2			89,458
1919	2			127,111
1920	2			208,302
1921	2			202,333
1922	2		2	2
1923	2			516,936
1924	2			356,035
1925	2			244,602
Totals	2434,808	\$2,619,750		*\$3,813,748

*Estimated.

¹Includes crushed rock, rubble, rip-rap, sand, gravel²See under 'Unapportioned.'

The mineral deposits have been described in detail in various early reports of the State Mineralogist; the most recent complete data on the county being contained in Report XIV, 1913-14. In order to bring these data up to date, the county was visited in August, 1926, and all new developments noted are included in this revision.

ASPHALTUM.

Along the shore-line cliffs west of Bolinas, from Duxbury Point north for a distance of over three miles, there are several small occurrences of asphaltum in Monterey shale. These appear to be residues from oil seepages. The shale strata strike southeast and dip to the west at an angle of 45° to 50°. At Duxbury Point the shale beds are massive and continue for some distance into the sea, forming the well-known Duxbury Reef. In the cliffs at this point the asphaltum occurs in thin seams cutting across and nearly normal to the dip of the strata. The deposits, as a whole, are small and unimportant.

Bibl: State Mineralogist's Reports XIV, p. 249; XIII, p. 36; XIV, p. 241.

1888-1925.

Mineral water		Miscellaneous and unapportioned		
Gallons	Value	Amount	Value	Substance
		7,000 cu. ft	\$5,000	Granite
		700 tons	1,400	Salt.
		150 tons	300	Salt.
52,000	\$12,050			
47,500	5,075		42,000	Unapportioned, 1900-1909.
100,000	10,000			
328,740	36,500			
260,000	31,000			
60,000	9,000			
60,000	9,000			
60,000	9,000			
2			74,000	Brick and mineral water.
2			113,720	Brick and mineral water.
2			86,725	Brick, copper, gold, mineral water, silver.
2			101,863	Brick and mineral water.
2			127,443	Brick and mineral water.
2			116,443	Brick and mineral water.
2			403,099	Brick, mineral water, potash, miscellaneous stone.
			171,945	Brick, clay, mineral water.
			171,196	Brick, pottery clay, mineral water.
			193,200	Brick, clay and mineral water.
2				
2962,240	\$121,625		\$1,605,334	

BRICK AND CLAY.

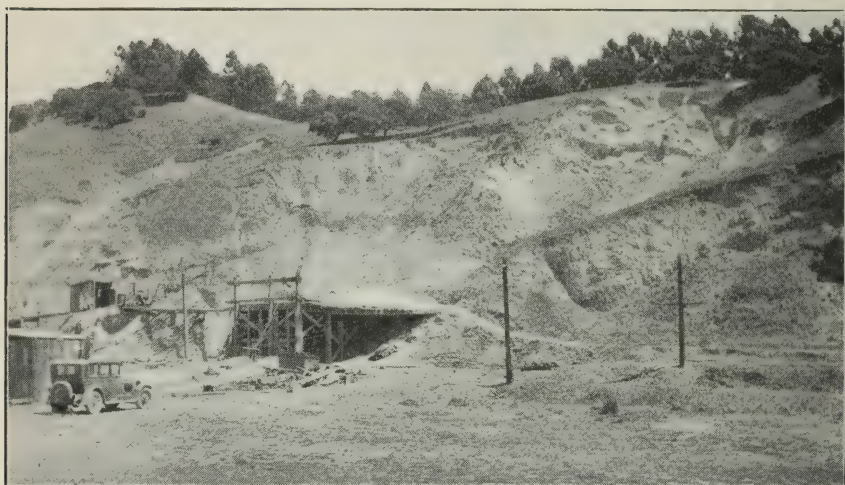
Clay products, notably common bricks, have been produced in this county since 1870, but no records of output before 1888 are available. Three plants have been located here in the past. One plant at present is steadily producing.

McNear Brick Company. E. B. McNear, president; home office, 417 Berry Street, San Francisco. This plant is on tidewater at McNear's Point, four miles east of San Rafael, which is the nearest railroad shipping point. Most of the product is shipped by barges to various bay points. Bricks have been made here for many years and the clay and shale now have to be transported a considerable distance to the plant. The clay and shale deposits overlay Franciscan metamorphic sandstone which forms the body of the hills. Blasting is occasionally required and electricity is used for detonating the charges. An electrically operated dragline scraper brings the loose material to a loading hopper from which it is drawn into cars. These are hauled to the brick plant in trains of four cars each by a Baldwin Westinghouse-equipped electric locomotive, discharging to storage bins. The 'dry-pan process' is used and after crushing and screening, the dampened clay is fed to

the pug-mill and auger stiff-mud machine. A wire brick-cutter cuts the bricks to proper size and they are discharged on to a belt conveyor. The 'green' brick are taken from the belt and stacked on trucks and trammed to the storage sheds. A small hand-operated jack lifts the entire load, cross pieces are slipped under, permitting it to rest on the drying-rack, and the truck is then withdrawn and returned for another load.

The brick-forming end of the plant has a capacity in excess of the kilns and this excess is stored for burning in the winter. The plant has an annual capacity of 20,000,000 bricks. There are two Hoffmann continuous kilns.

The Hoffmann kiln consists of an arched, tunnel-shaped, firing chamber, either circular or oval in plan, or of two parallel tunnels joined by circular ends. The furnaces at the McNear plant are of the last-named type. This produces an endless kiln capable of being



Clay and shale deposit of McNear Brick Company, showing loading hopper.
Marin County.

subdivided into a series of chambers of nearly equal size by means of cross partitions of a temporary character. From each chamber three flues lead respectively to: the central stack; the chamber preceding it in the series; and the chamber following it. Each of these flues may be closed at will by the insertion of a partition of sheet iron. Each compartment also has a doorway connected with the outside for charging and discharging. Slack or other fine coal is fed in at the top of the chambers and one chamber is fired. The flues leading to the stack are closed except that from the newest chamber charged, behind the one fired. The interchamber flues are left open except the one between the fired chamber and that behind it in the series. By this arrangement the hot gases from the fired chamber pass successively through the other charged chambers, finally passing out from the last one to the central stack. When the bricks in the fired chamber are sufficiently burned, it is allowed to cool by closing its flues, and the next chamber

ahead is fired. After removing the burned bricks the compartment is recharged and its flues opened *to* the stack and *from* the chamber behind it.

A barge load of oil coke, a cheaper fuel than coal, is being tried out at present, and promises to give satisfactory results. From 45 to 50 men are employed.

Bibl: State Mineralogist's Reports VIII, p. 342; XII, p. 382; XIII, p. 615; XIV, p. 244. Bull. 38, p. 249.

Patent Brick Company. A former plant at Gallinas Station on the Northwestern Pacific Railroad has been dismantled, and this company is out of business. The *Hidecker Brick Co.*, 24th and Union streets, Oakland, occasionally crushes some of the old brick at this place for roofing material.

Bibl: State Mineralogist's Reports XII, p. 382; XIII, p. 615; XIV, p. 247. Bull. 38, p. 250.

Remillard Brick Company. This company's former plant at Green Brae has been dismantled for about 15 years.

Bibl: State Mineralogist's Report VIII, p. 342; XII, p. 382; XIV, p. 248. Bull. 38, p. 250.

Louis Sbarbori, 554 Broadway, San Francisco, has recently leased the Remillard property and will begin the manufacture of floor tile as soon as machinery is installed. Production is expected to start in about six months.

Common red-burning clays appear to be fairly abundant in the county but none is utilized at present except that at the McNear Brick Company's plant. Good clay, from which pottery was made on a hand scale at one time, is reported to occur on the Bothin tract near Fairfax. Kaolin has been found near Duncan Mills. Clay deposits also are found on the old Maillard Ranch, now owned by the Lagunitas Development Company, 833 Market Street, San Francisco.

Bibl: State Mineralogist's Reports V, p. 108; XI, p. 253; XII, pp. 329, 382; XIII, 506; Bull. 38, p. 362.

CHROMITE.

No commercial deposits of chrome ore are known within the county, but there are reported to be small occurrences on the Maillard Ranch, now owned by the Lagunitas Development Company, 833 Market Street, San Francisco, and included in their subdivision at Woodacre.

COAL.

There is a specimen of lignite in the museum of the State Mining Bureau from the Barton Ranch on Tomales Bay; and a small broken vein of coal—a shaly lignite—was found in the Escalle Quarry at Escalle Station.

Bibl: State Mineralogist's Reports XI, p. 251; XIV, p. 248; U. S. Geol. Survey Min. Resources, 1891, p. 214.

COPPER.

In 1863 two or three companies did some work on a series of copper prospects about a mile east of Woodville (then Dogtown), north of Bolinas, and a small tonnage of sorted ore was shipped for treatment.

The Bolinas Copper Mining Company, T. P. H. Whitelaw, manager, in 1900 shipped some copper ore from the same locality, but nothing has been done since.

Bibl: State Mineralogist's Reports V, p. 98, XI, p. 253; XIII, p. 59; XIV, p. 248; Bull. 20, p. 14, Bull. 50, p. 168.

Some nice specimens of copper ore have been obtained and several are on exhibit in the State Mining Bureau museum, but it is not believed that the deposits are extensive enough to be classed as an economic resource of any importance.

GEM MATERIALS.

Garnets occur in mica schist near California City on the Tiburon Peninsula. The most common variety is andradite, a lime-iron garnet.

So-called moonstones (principally translucent quartz) are found as pebbles along the ocean beach. They are especially abundant near Bolinas Point.

Jasper occurs quite plentifully in Marin County, associated with Franciscan cherts. Dr. S. M. Augustine, of Berkeley (formerly a resident of San Rafael), made a large and beautiful collection of polished specimens of red and yellow jasper and banded chalcedony from around San Rafael, Sausalito, and other parts of Marin County. It makes beautiful jewelry but is too expensive to collect and prepare. It is highly siliceous and very hard, but is not obtainable in large enough pieces for building decoration. There is an infinite variety of coloring and figures.

Bibl: State Mineralogist's Report XIV, p. 249; Bull. 37, pp. 52, 78; Bull. 38, p. 366; Bull. 91, p. 88.

MAGNESITE.

Magnesite occurs at Woodacre on the property of the Lagunitas Development Company, 833 Market Street, San Francisco. It is said to have been investigated during the war period and found not to be of commercial value.

MANGANESE.

Manganese in the form of psilomelane is found on the Maillard Ranch, one-half mile south of Woodacre, a subdivision owned by the Lagunitas Development Company, 833 Market Street, San Francisco. It occurs as stains and irregular masses in red jasper. The manganese is high in silica and, though investigated with a view to working during the late war period, the deposit was never developed, and probably is too low grade to be marketable.

About one mile west of Sausalito Point manganese oxides occur, associated with massive jasper. The material is mostly of low grade, but one streak of fine ore, 15 inches in thickness, could be traced about six feet.

Another deposit was exposed in a road cut near Fort Baker and was described by A. C. Lawson¹ as follows: "The manganese is well exposed as a stratified deposit of hard, clean psilomelane about 18 inches thick, grading off in its upper part to a lean ore consisting of chert and shale highly charged with the black manganese mineral. There is no definite boundary between this lean ore and the normal radiolarian cherts, for the proportion of psilomelane simply decreased till it ceases to color the rock. The thickness of the ore-impregnated cherts above the layer of psilomelane is about 12 feet. This body of ore lies within a few feet of an intrusive contact of ellipsoidal basalt with the cherts, the contact plane being parallel to the bedding, and may be traced for 90 feet on the outcrop of the formation, which dips about 40 degrees southwest. In several samples taken by D. C. Billiek, the psilomelane contains gold not exceeding 40 cents to the ton."

MINERAL WATER.

There are several small mineral springs in the county, some of which are not improved or utilized; mineral water, however, has been one of Marin County's commercial products for nearly 20 years.

Ancha Vista Hotel Spring. Dave Davis, owner, San Anselmo. This spring is in sandstone on the slope of Red Hill at San Anselmo; elevation 150 feet. It has been known for over 40 years, but utilized medicinally for the last 15 years only. An analysis is reported to show 21 grains per gallon, principally magnesia and lithia. The flow is about 100 gallons per day. It is used for drinking only. None is bottled.

Bibl: State Mineralogist's Report XIV, p. 249.

El Toro Spring. This is a mildly sulphurated spring on the Taylor Ranch, 2½ miles northwest of Novato. The water was bottled at one time, but it is not utilized at present.

Bibl: State Mineralogist's Report XI, p. 251; XIII, p. 512; XIV, p. 250; U. S. Geol. Survey Water Supply Paper 338, p. 255.

Rocky Point Hot Sulphur Springs. This is a warm, mildly sulphurated spring on the beach, about six miles northwest of Point Bonita. It is exposed only at low tide.

Bibl: State Mineralogist's Reports XI, p. 250; XII, p. 512; XIV, p. 250; U. S. Geol. Survey Water Supply Paper 338, p. 80.

Tamalpais Mineral Water Spring. Borello Bros., owner. This is a drilled well at First and Hayes streets, San Rafael; elevation 50 feet (U. S. G. S.). The well was sunk in 1903, and the water analyzed in December, 1904, followed immediately by bottling operations. It is 26 feet deep, not artesian, and has no contained gas. It is bottled, carbonated, and is also used in the manufacture of soda water and other flavored soft drinks. Temperature 60° F. A 3-h.p. electric motor runs the pump and bottling machines.

Bibl: State Mineralogist's Report XIV, p. 250; U. S. Geol. Survey Water Supply Paper, 338, p. 307.

¹ Lawson, A. C., U. S. Geol. Survey San Francisco Folio, No. 193, p. 23.
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Woodacre Iron Spring. On the property of the Lagunitas Development Company (formerly the Maillard Ranch) at Woodacre. Not utilized.

NATURAL GAS.

An inflammable gas escapes from the reef at Duxbury Point, near Bolinas. It can be observed only at extreme low tide. It is stated that natural gas has also been detected near Nicasio.

Bibl: State Mineralogist's Reports VII, p. 184; XIII, p. 567; XIV, p. 250.

PETROLEUM.

The possibilities of obtaining commercial quantities of oil in Marin County were investigated by Vander Leck¹ and are discussed in Bulletin No. 89 (out of print). His conclusions are given as follows:

"The country lying west of the San Andreas Fault is called the Point Reyes Peninsula and as a result of being on the downthrow side of the fault rocks of Miocene and Pliocene age are found exposed in this district.

"These formations consist of bituminous shale of the Monterey formation and loose marine sands of the Merced formation (Lower Pliocene).

"The Monterey shales cover about nine-tenths of the peninsula. In the northern portion near Inverness and Tomales Bay they rest directly on the granitic rocks. At Bolinas Point and Duxbury Reef the shales are distinctly bituminous and there are small seepages of heavy black oil at both of these localities. Due to the close proximity of the shales to the fault zone, they have been intensely folded and crushed, which obscures the true nature of the structure. However, there are at least two well defined anticlines on the peninsula as well as numerous minor folds. The axis of the most westerly fold may be seen along the beach one-half mile west of the town of Bolinas where it strikes N. 30° W. The axis of the second fold runs along the high ridge about one-half mile west of Pine Gulch and Olema Creek. This strikes in a general northwest direction. The total thickness of the Monterey in this area is about 4000 feet. The Merced sands occupy a small area in Paradise Valley, just north of the town of Bolinas. The total thickness of these sands is about 600 feet and the general dip is about 30° to the east. Ordinarily it would be expected that these sands would be petroliferous, as they overlie the bituminous shale; this is not the case, however, as they show no evidence of any oil content. This lack of oil is probably due to the great unconformity between these beds and the Monterey shale. Three wells have been drilled just west of the town of Bolinas on the Garzolia Ranch. Two of these were drilled about one-fourth of a mile west of the ranch house at the head of a small gully. These wells were drilled to a depth of about 1800 feet in the Monterey. The one nearest the ranch house encountered no oil; the one nearest the ocean had a small showing at 700 and 1200 feet. A third well was drilled on the sea cliff just back of Duxbury Reef. This well went into the Monterey for 2800 feet and encountered small showing at 200 and 2400 feet. These wells were drilled about 1905.

"The possibility of obtaining oil in commercial quantities in this district is not very good. The Upper Miocene sands which once probably overlaid the Monterey shale and in which the oil content of the shales probably collected have been removed by erosion. Such oil as remains is in small quantities in fractured zones in the shale and it is doubtful if anything more than a showing would be encountered in any well drilled in this area."

"Both the character and age of the rocks in the country lying east of the fault preclude their being oil-bearing, and this district may be dismissed as having no oil possibilities."

SALT.

Salt was first made from the bay water by evaporation at San Rafael in 1867. More recently the Golden Gate Salt Company reported an output for a time, but there has been no plant in operation since 1909.

Bibl: Bull. 24, p. 106.

¹ Vander Leck, Lawrence, Petroleum Resources of California, State Mining Bureau Bull. No. 89, pp. 35-36.

STONE INDUSTRY.

Rubble and crushed rock have accounted for a large proportion of the mineral output of the county, and they will probably continue to be among its chief mineral products. Some 15 quarries are described by name in State Mineralogist's Report XIV, 1913-14, about half of which were operating, at least intermittently, at that time. There are now two large rock-crushing plants, and practically all other quarries are idle. Those not active will be only briefly mentioned.

Daniel Contracting Company (Bull Quarry, also McNear Quarry). Home office, 503 Market Street, San Francisco; John H. Hopps, vice president and general manager. This company operates on a large scale on land owned by the McNear Company, Inc., at Point San Pedro, six miles east of San Rafael. The property now includes the adjoining quarry formerly operated by the San Francisco Quarries Company, and the quarry face is extensive. There are three stiff-leg derricks for handling rubble and two traveling cranes of seven to ten tons capacity. A new loading derrick for crushed rock is being constructed. Practically all material is shipped by barge. Shovel equipment includes 2-70's and 1-65 Bucyrus oil-fired steam shovels and 1-M37 Marion electric. There are two American, two Porter, one Vulcan and three Davenport steam locomotives, 51 side-dump cars, 14 small flats (1 pair of trucks) and 12 large flat cars (2 pair of trucks). The crushing plant contains a 48-inch by 60-inch primary jaw crusher, a No. 8 McCully secondary crusher, two 48-inch and one 24-inch Simonds disc crushers. The standard sizes of crushed rock produced are: No. 4, $\frac{1}{8}$ "- $\frac{3}{4}$ "; No. 3, $\frac{3}{4}$ "-1 $\frac{1}{4}$ "; No. 2, 1 $\frac{1}{4}$ "-2 $\frac{1}{2}$ ". None of the material is washed. The rock is mostly a hard, bluish-gray Franciscan metamorphic sandstone.

In blasting, heavy charges are used. The last combination shot required 455 feet of tunnel and 2500 feet of 6-inch holes. Fifty-five tons of explosive were used, 20% of which was 60% dynamite and the remainder 40% to 10%. The 10% explosive was loaded in the tunnel and the 40% and 60% dynamite in the holes. After the blast it was estimated that there were 168,000 tons of broken rock in front of the blast and a total of 300,000 tons broken. The capacity of the plant is 1200 tons per day. Electric power is used for the compressors and crushing department, the connected load being 680 horsepower. Forty-eight men are employed.

Bibl: State Mineralogist's Report XIV, p. 250; Bull. 38, p. 318.

Escalle Quarry. A small quarry in a ravine at Escalle Station. Idle.

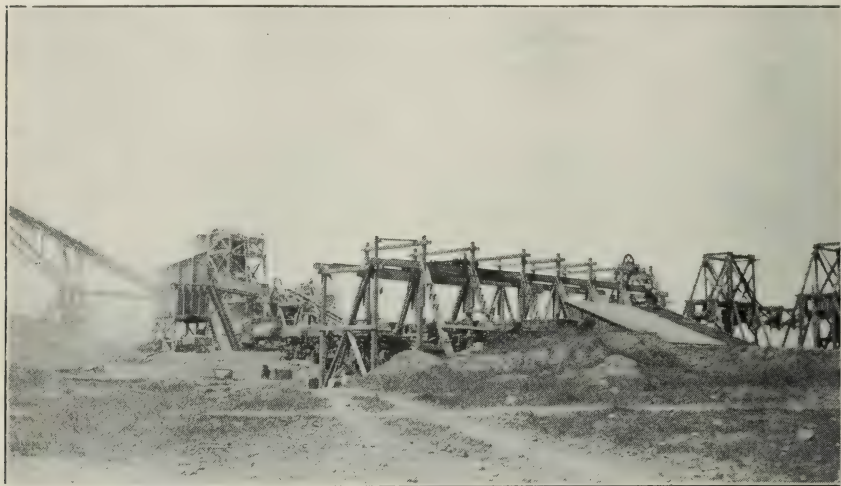
Bibl: State Mineralogist's Report XIV, p. 254.

Forbes Quarry. A red chert quarry at the north edge of San Rafael. Idle.

Bibl: State Mineralogist's Reports XII, p. 389; XIII, p. 625; XIV, p. 254; Bull. 38, p. 318.

Fort Baker Quarry. U. S. Government, owner. It was in active operation during the building of the Panama Pacific Exposition, but has been idle since then. The rock is a dark, fine-grained, greenish and brown metamorphic sandstone.

Fort McDowell Quarry (Angel Island Quarry). U. S. Government, owner; Quartermaster at Angel Island, in charge. This quarry has furnished a large amount of rock for construction work at Fort Mason, the Presidio, and Alcatraz Island. The last operation on a large scale was for harbor work at Point Richmond in 1922. There is a crushing



Crushing plant at Daniel Contracting Company's quarry, Point San Pedro, Marin County.



Quarry face at Daniel Contracting Company's quarry, Point San Pedro, Marin County, showing result of recent large blast.

plant here which is operated as occasion demands, the material now being used for making concrete poles and on the roads.

Bibl: State Mineralogist's Report XIV, p. 254.

Hoffman Quarry. A small quarry, three miles north of San Rafael. Idle.

Bibl: State Mineralogist's Report XIV, p. 255; Bull. 38, p. 319.

Hotaling Quarry. At the south end of Clark Street, San Rafael. Idle.

Bibl: State Mineralogist's Reports XII, p. 389; XIII, p. 625; XIV, p. 255; Bull. 38, p. 319.

Hutchinson Company, Inc. (Green Brae Quarry; Quarry No. 3). Home office, 1706 Broadway, Oakland; Dwight Hutchinson, president; H. Hardy, secretary. The Green Brae quarry of Hutchinson Company, Inc. was opened up in July, 1925, and crushed rock output began in March, 1926. The property comprises 200 acres covering hills composed of hard metamorphic sandstone, adjacent to Green Brae Station on the Northwestern Pacific Railroad and tide water.

The quarry at present is an open-cut, but a tunnel is now being driven into the hills and glory-hole operations will be carried on from it. In the open-cut workings, 22-foot toe holes are put in with air drills. After shooting, the broken rock is picked up by two Erie oil-fired steam shovels, with $1\frac{1}{4}$ -yard buckets and loaded into automatic side-dump cars of 4- and 5-yard capacity. Two Plymouth gasoline motors haul the rock in trains of four cars each to the primary crusher bin. The primary is a Buchanan 36-inch by 42-inch jaw crusher. The discharge is carried by a 36-inch belt to two No. 7 $\frac{1}{2}$ Allis Chalmers gyratory crushers. A scalping screen is being installed between the primary and gyratory crushers, but is not yet in use. The product of the No. 7 $\frac{1}{2}$ gyratory crushers passes by a 30-inch belt conveyor to the screens. There are two revolving trommels and two Link-Belt screens. Oversize from the trommels goes to two No. 6 gyratory crushers and their discharge to No. 2 conveyors. Practically any size can be produced, the standard sizes being Macadam (No. 2), $1\frac{1}{4}$ "-2 $\frac{3}{4}$ "; Concrete (No. 3), $\frac{3}{4}$ "-1 $\frac{1}{4}$ "; Screenings (No. 4), $\frac{1}{4}$ "- $\frac{3}{4}$ "; Birdseye, $\frac{1}{4}$ "; rock dust; crusher run (mixed) and rubble rock. Chutes from the storage bins are arranged for loading trucks or railroad cars, a spur track running to the plant. A 500-foot 30-inch belt conveyor equipped with an automatic Merrick Conveyor weightometer delivers from any bin to barges for water transportation. The yard storage is handled by a Brownhoist steam crane with $1\frac{1}{4}$ -yard bucket mounted on railroad trucks.

Electric power, furnished by the Pacific Gas and Electric Company, is used, the connected load being 700 horsepower. The plant has a capacity of 1600 tons per day. Forty-five men are employed.

Bibl: Explosive Engineer, August, 1926.

Marin Rock Company. Formerly operated a quarry on the west edge of San Anselmo. Out of business.

Bibl: State Mineralogist's Report XIV, p. 255.

Northwestern Pacific Railroad Company. Intermittently operates quarries at Black Point, Tiburon Point, Waldo, and other localities for ballast and fill.

Bibl: State Mineralogist's Report XIV, p. 256; Bull. 38, p. 319.

Point Bonita Quarry (Fort Barry). U. S. Government, owner. Idle since 1917. A second quarry was opened here and operated for a few years, but has been idle since 1920.

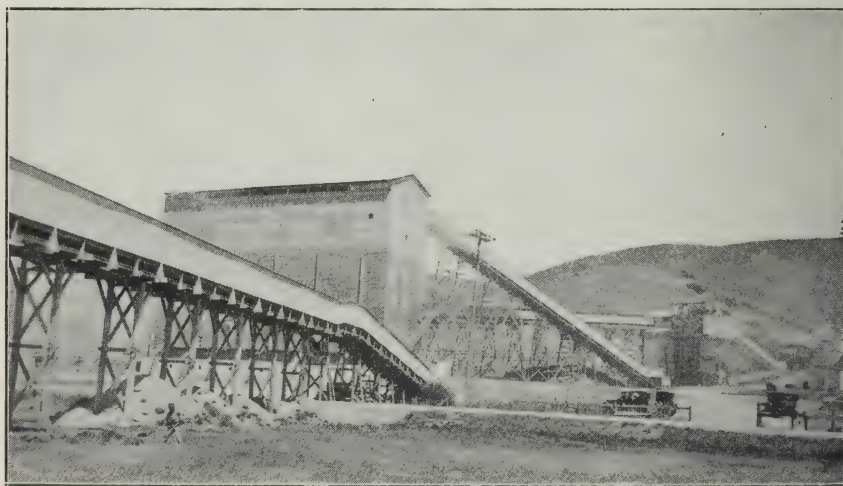
Bibl: State Mineralogist's Report XIV, p. 256.

San Francisco Quarries Company. This quarry is now a part of that of the Daniels Contracting Company.

Bibl: State Mineralogist's Report XIV, p. 258; Bull. 38, p. 319.



Open cut at Green Brae Quarry of Hutchinson Company, Inc., Marin County.



Crushing plant of Hutchinson Company, Inc., at Green Brae quarry, Marin County.
The conveyor in foreground discharges to barges on tide water.

Short Ranch Quarries. Owned by Bennett and Croker, San Anselmo. The rock is a blue metamorphic sandstone. Operated intermittently. Idle.

Bibl: State Mineralogist's Report XIV, p. 260.

SONOMA COUNTY.

C. MCK. LAIZURE, Mining Engineer.

Introduction.

Sonoma is one of the original counties created in 1850. At that time its northern boundary was described as follows¹: "Beginning at the sea coast at the mouth of Russian River and following up the middle of said river to its source in the range of mountains called Mayacmas." The eastern and southern boundaries were practically the same as they are today except that Mare Island, Solano County, was at first included in Sonoma. A number of changes were later made in the northern boundary and eventually the area north and west of Russian River, as far as the present Mendocino line, became part of Sonoma County. These changes cut off from Sonoma that portion east of Russian River and north of the present Mendocino County line. As now defined, Sonoma has a land area of 1577 square miles. Its population is 51,990 (1920 census).

Geography and Topography.

Sonoma County is situated north of Marin County and San Pablo Bay, extending eastward from the Pacific Ocean, which it borders for 50 miles, to the crest of the Coast Range, which forms the boundary separating it on the east from Lake and Napa counties. Mendocino County bounds it on the north. There are no improved harbors on the coast side, but water shipping facilities are available in the southern portion, which borders the bay. The Northwestern Pacific Railroad traverses the county from south to north through the central valley, with branch lines into Sonoma Valley, to Sebastopol and to the Russian River region around Guerneville, Duncan Mills and Cazadero. A narrow-gauge branch also extends from Marin County northward through Valley Ford to Monte Rio in the western part. A line of the Southern Pacific Railroad from Napa Junction in Napa County traverses the Sonoma Valley and terminates at Santa Rosa. The Petaluma and Santa Rosa electric system also gives service to the southern portion of the county. The paved 'Redwood Highway' of the State system closely parallels the Northwestern Pacific Railroad through the county. Its main laterals are also paved or well-kept graveled roads.

The county produces a great variety of agricultural products but especially prunes, apples, grapes, pears, and other fruits; poultry raising and egg production are highly developed industries and dairying and stock-raising are important sources of wealth. Its mineral deposits have been exploited more or less continuously since the sixties, and although it can scarcely be classified as a 'mining' county, metals and non-metallic minerals exceeding 11 million dollars in value have been produced to date. Its resources are still far from exhausted.

Many health-giving mineral springs are found here, and its resorts have made the county one of the favorite playgrounds of central California.

Situated in the midst of the Coast Range, its topographic features include level valleys, low rolling hills and rugged mountains, with deep-cut canyons. The drainage of the southern portion is to the bay,

¹ Coy, Owen C., California County Boundaries, California Historical Survey Commission, Berkeley, 1923.

while that of the northern two-thirds is to the Pacific Ocean, chiefly by the Russian River and its tributaries. The main valley area, beginning at the bay, extends through the center of the county for about 60 miles, with an average width of 25 miles, but narrowing toward the northern end. Numerous smaller valleys separate the lesser spurs and ridges of the main range.

Geology.

Sonoma County is not covered by any of the United States Geological Survey Folios and the geologic literature on this area is fragmentary. The general geology has been described in part by Osmont¹; and by Vander Leek², in its relation to possible oil production. The geology of the quicksilver ore deposits has also been covered in considerable detail by various writers.

As shown on the State Mining Bureau's geological map of the state, the Franciscan rocks of the Coast Range cover probably three-fourths of Sonoma County, extending in a broad belt from the Marin County line northwesterly the entire length of the county and beyond. This belt of metamorphic rocks widens toward the north. It consists mainly of sandstone, with smaller amounts of limestone, slates, cherts, schist, and much serpentine. Bordering the coast from Salmon Creek north, is a belt of Cretaceous sandstone and shale a few miles in width. Tertiary sedimentary rocks are exposed in a small area around Valley Ford. The main valley area is composed of Quaternary sands, gravels, and clays along the Russian River from Cloverdale to Healdsburg. These formations narrow at Windsor and then widen again between Forestville and Santa Rosa and continue south through Sebastopol and Cotati nearly to Petaluma. The lowlands area around the mouth of Petaluma Creek and Sonoma Creek is also of Quaternary age. Most of Sonoma Valley, the Sonoma Hills and the area surrounding Santa Rosa on the east and north is made up of Tertiary sediments consisting of fine and medium sands, clay and shale. Late volcanic lavas cover a considerable area in the neighborhood of Mount St. Helena. They also appear along the eastern boundary of the county, on the west side of Sonoma Valley, and near Petaluma. The lavas are mainly andesitic, but in places grade into basalt. Volcanic tuffs are found interbedded with the Tertiary sediments at many points.

Mineral Resources.

Sonoma County has contributed to the mineral output of the state since prior to the sixties. The earliest segregated county records, however, do not begin until 1873. Its resources embrace a varied list of products, both metallic and non-metallic. The output of some of these materials has been practically continuous since it began; others have been produced for a time only and then operations have ceased as economic conditions have changed.

Commercial production has been made of quicksilver, miscellaneous stone, brick and clay, mineral water, mineral paint, magnesite, graphite, lime, diatomaceous earth, gems, chromite, and manganese. To

¹ Osmont, V. C., A Geological Section of the Coast Ranges North of San Francisco, Bull. Dept. of Geol., University of California, Vol. 4, No. 3, pp. 39-87.

² Vander Leek, Lawrence, Petroleum Resources of California, State Min. Bur. Bull. 89, pp. 36-38.

the list may now be added petroleum. Occurrences are also known of arsenic, coal, sulphur, cobalt, copper, gypsum, gold, pyrite, stibnite, iron, zircon and onyx. Besides these, fully a dozen other mineral species not commercially used have been reported.

The recent discovery of a new mineral, Curtisite, is of academic interest.

The drilling of natural-steam wells at The Geysers in this county is probably the most unusual power development activity in the United States, its latent capacity being measureless.

The last general report on the mineral resources of Sonoma County is contained in State Mineralogist's Report XIV, 1913-14. A few additional data are contained in Report XVII, 1920. The quicksilver mines are described in detail in Bulletin No. 78, 'Quicksilver Resources of California,' 1918. Bulletin No. 79, 'Magnesite in California,' includes the deposits here, and Bulletin No. 76 covers the chromite and manganese occurrences. The possibilities of petroleum production are discussed in Bulletin No. 89, 1921 (out of print). Although previously published reports are fairly complete, in order to bring these data up to date in conformity with the new series of county reports begun in State Mineralogist's Report XXI, 1925, the county was visited in August, 1926, and all new developments and changes in the status of the industry that came to the writer's attention are included herein.

As the deposits of quicksilver, manganese, chromium and magnesite are covered in detail in the special bulletins mentioned, which are still available, extended descriptions in this report would be a useless repetition.

The accompanying table gives the total recorded mineral output from 1873 to 1925, inclusive. In 1925 the output was valued at \$160,231 and the county ranked forty-fourth among the 58 counties of the State.

Year	Quicksilver		Mineral paint		Brick	
	Flasks	Value	Tons	Value	M.	Value
1873	50	\$4,017				
1874	1,700	178,806				
1875	1,218	102,495				
1876	3,897	171,468				
1877	3,609	134,616				
1878	3,255	106,890				
1879	2,977	88,923				
1880	1,445	44,795				
1881	1,273	37,974				
1882	2,124	59,960				
1883	1,669	47,984				
1884	332	10,126				
1885	446	13,715				
1886	735	26,093				
1887	689	29,196				
1888	1,151	48,918			1,000	\$5,000
1889	1,345	60,525			1,000	5,000
1890	1,046	54,915				
1891	1,660	75,115				
1892	1,630	66,357				
1893	1,445	53,104				
1894	1,368	41,998	100	\$3,500	375	1,875
1895	1,813	70,707	225	3,375	350	1,750
1896	1,126	37,150	220	3,740	250	1,250
1897	1,538	59,982	270	3,780	300	1,500
1898	1,704	63,048			350	2,800
1899	2,119	105,950			200	1,800
1900	2,209	99,500			280	2,360
1901	2,130	95,850			150	1,200
1902	1,440	64,685	30	105	150	1,200
1903	2,404	98,676	800	320	160	1,440
1904	2,700	102,829			175	1,750
1905	2,504	97,041			500	4,000
1906	2,070	75,555			6,800	115,000
1907	560	21,369			11,600	133,479
1908	590	24,939			11,000	83,000
1909	344	14,226			6,500	29,000
1910	260	11,765				
1911	94	4,325				
1912	646	27,158				
1913	12	483				
1914	13	638				
1915	159	21,793				
1916	1,039	97,146				
1917	2,592	244,810				
1918	2,417	280,333				
1919	1,418	119,142				
1920	^s					
1921	^s					
1922	^s					
1923	528	31,147				
1924	867	60,840				
1925	351	29,134				
Totals	570,791	\$3,418,211	1,645	\$14,820	41,140	\$393,404

¹Includes crushed rock, rubble, rip-rap, paving blocks, sand, gravel.

²Eleventh Census Report, Vol. X, Part 3, p. 605.

³Estimated.

⁴Flasks of 75 pounds since June, 1904. Previously 76½ pounds.

⁵See under 'Unapportioned.'

⁶There was a considerable production of paving blocks in Sonoma County in the 70's and '80s, but no available records of annual amounts or values.

1873-1925.

Mineral water		Miscellaneous stone ¹ , value	Magnesite		Miscellaneous and unapportioned		
Gallons	Value		Tons	Value	Amount	Value	Substance
		5					
		\$350,000					
		367,500					
		*297,236					
		*245,000					
		*150,000					
		96,000					
		92,800					
		57,381					
8,000	\$32,500	69,508					
14,400		19,287					
236,000	24,000	73,719					
246,680	23,490	33,035					
21,000	18,500	43,371					
575,000	35,000	16,830					
60,900	17,691	20,275					
30,000	9,100	52,701	175	\$1,225	64 tons	\$4,460	Graphite.
10,000	4,000	121,578	130	455	42 tons	1,680	Graphite.
11,000	4,400	90,933					
10,000	4,400	75,947			1,500 bbls.	2,250	Lime.
10,000	4,000	213,830					
10,000	4,000	158,218					
12,000	4,200	132,946	250	1,250	{ 1,500 bbls.	300	Gems.
10,000	1,000	307,695	15	180	{ 10,500 tons	2,600	Lime.
104,000	21,350	319,716			{ 2,600 tons	50	Gems.
					{ 500 tons	10,700	Clay.
235,000	50,350	220,998				3,000	Clay.
202,500	50,250	184,035				5,500	Clay.
62,500	20,950	295,198	300	3,000		15,000	Unapportioned, 1900-1909.
96,240	46,910	191,436					
80,015	46,160	276,516	213	2,130		1,000	Unapportioned.
258,600	41,231	177,917	3,624	34,788			
121,366	28,031	232,113	11,653	98,280		700	Other minerals.
						375	Other minerals.
					243 tons	2,478	Chromite.
						14,000	Building stone, manganese.
					226 tons	6,200	Chromite.
121,290	35,031	146,621	5,636	61,335	362 tons	12,689	Manganese.
						64	Other minerals.
83,220	36,050	148,347	4,110	40,010	1,540 tons	73,906	Chromite.
					173 tons	7,645	Manganese.
96,800	22,820	144,014				100	Other minerals.
29,928	6,578	217,667				62	Building stone, curbing
37,641	9,891	151,300	5			63,000	Magnesite, quicksilver.
35,843	9,108	162,679	5			14,360	Gems, magnesite, quicksilver.
30,661	7,106	189,059				50,154	Pottery clay, gems, quicksilver.
31,003	8,002	101,009					
17,713	6,679	119,546				2,200	
						4,872	Pottery clay, building stone, manganese.
2,899,300	\$647,665	\$6,344,674	\$25,236	\$242,653		\$299,345	

BRICK AND CLAY¹.

There has been in the past a considerable output of brick and clay in Sonoma County, but no clay-working plants are active at the present time, and clay production is almost negligible. Undoubtedly there are many undeveloped clay deposits of potential value. There are samples of clay in the State Mining Bureau museum from Agua Caliente, Guerneville, Healdsburg, Mark West Springs, Santa Rosa, and Sonoma, none of which have been developed. Plants were formerly operated at Glen Ellen, Healdsburg, and Hilton. Most of the material is only suitable for the manufacture of common red brick and tile, but some deposits are of more valuable clays. A small deposit of high-grade pottery clay is reported on the James Henderson Ranch at Glen Ellen. At Skaggs Springs there is a deposit of yellow clay, stated to be suitable for the manufacture of terra cotta.

Weise Clay Pit (also known as Beltane Clay). J. H. Weise, owner, Glen Ellen; Frank Asbury, Los Angeles, lessee. This deposit of white kaolin is in a hill about $\frac{1}{4}$ mile northeast of Beltane Station, between Glen Ellen and Kenwood. It is a high-grade aluminum silicate. A considerable tonnage has been used in the past by Gladding McBean and Company in the manufacture of fire brick, and by the Santa Cruz Portland Cement Company in the manufacture of a special white cement. Its fusion point is stated to be very high—about 4500° F. The present lessee has shipped a carload or two to Los Angeles for testing in the manufacture of fire brick. There is estimated to be at least 100,000 tons available.

Analysis of 'Beltane clay' by Smith, Emery and Company, Chemists, San Francisco.

	No. 1 (hard)	No. 2 (medium)	No. 3 (soft)
SiO ₂ -----	74.60%	56.29%	58.10%
Al ₂ O ₃ -----	15.97%	31.13%	26.79%
TiO ₂ -----	.21%	.31%	.56%
Fe ₂ O ₃ -----	.50%	.59%	1.17%
MnO -----	Trace	Trace	Trace
CaO -----	.18%	.05%	.32%
MgO -----	.06%	.05%	.05%
Loss on ignition -----	8.80%	11.67%	12.66%
	100.32%	100.09%	99.65%

Bibl: State Mineralogist's Reports VIII, p. 635; XII, p. 384; XIV, pp. 316-318; Bull. 38, p. 258.

CHROMITE.

Deposits of chrome ore occur in a belt of serpentine that strikes northwestward through the western portion of the county. In this same serpentinized area some of the large magnesite deposits occur, notably those in the Red Slide district north of Cazadero. A large tonnage of chromite is reported to have been shipped from the properties of the Asti Colony, three miles southwest of Cloverdale over 30 years ago. This was the only production prior to the period of activity brought on by the World War.

About two thousand tons of chromite were produced in this county during the war period, but most of the deposits consisted of small lenses and kidneys and were soon exhausted. There is no activity at the present time.

¹ The State Mining Bureau has in course of preparation a new bulletin on the clay resources of the State by W. F. Dietrich, Ceramic Engineer.

Madeira Deposit. Small lenses in Sec. 31, T. 9 N., R. 10 W. The ore was reported to assay 34% chromic oxide.

Meeker Chrome Mine. During the war period 1400 acres of the Meeker Estate at Camp Meeker were under lease and a number of small and medium size lenses of ore mainly in Sec. 16, T. 7 N., R. 10 W., were mined. This ore assayed 39%-40% Cr_2O_3 .

Parmeter Ranch Deposit (Laton Group). This deposit is in Sec. 13, T. 9 N., R. 12 W., eight miles by good road from Cazadero, the nearest railroad point. The deposit as a whole is low-grade, although some high-grade kidneys were taken out. Idle since 1918.

The *Shanks and Copps Lease* was in Sec. 13, T. 10 N., R. 11 W., on the ridge north of Skaggs Springs. A few small lenses of chromite were uncovered.

An unnamed deposit occurs two miles north of the Culver-Baer Quick-silver mine along the same ridge. About 150 tons have been shipped from here.

Bibl: State Mineralogist's Reports IV, p. 137; XIII, p. 50; XIV, p. 319; XVII, p. 248; Bull. 76, pp. 201-203; U. S. Geol. Survey Bull. 430, p. 168.

COAL.

Some small strata of coal are known at several points in Sonoma County, but they are not utilized. Some of these are:

At the head of a gulch $\frac{1}{4}$ mile from the beach near Fort Ross.

Eight miles east of Stewart's Point on the road to Skaggs Springs.

Pierson Mine, on the Wrightson Ranch, in Sec. 27, T. 8 N., R. 8 W., on the road to Mark West Springs. In 1910 and 1911 some development work was done.

On the *Taylor Ranch*, 2 miles south of Santa Rosa, considerable money was spent in development work about 30 years ago. Though a fair quality of coal was found, the strata were too much broken up.

Bibl: State Mineralogist's Reports VII, Pt. 1, p. 118; VII, pp. 151, 190; VIII, p. 634; X, p. 676; XI, p. 259; XII, p. 61; XIII, p. 55; XIV, p. 319.

COPPER.

Altamont Group. Small masses and specimens of copper ore have been found in Sec. 17, T. 7 N., R. 10 W., two miles south-east of Monte Rio.

Bibl: State Mineralogist's Report XIV, p. 319; Bull. 50, p. 167.

Archer Prospect. In Sec. 30, T. 8 N., R. 10 W., east of Guerneville.

Bibl: Bull. 50, p. 166.

Cornucopia Copper Mining Co. (Squaw Creek, also known as Healdsburg Copper). These claims are in Secs. 33 and 34, T. 12 N., R. 9 W., 14 miles northeast of Cloverdale. They were first located in 1902 and are reached by two miles of trail from the stage road to The Geysers. Assessment work is kept up. W. M. Jacobs, of Healdsburg,

is the principal. Cobalt is associated with the deposits here as indicated by samples submitted to the State Mining Bureau laboratory.

Bibl: State Mineralogist's Reports V, p. 97; XIV, pp. 319-320; Bull. 50, pp. 166-167.

DIATOMACEOUS EARTH.

Infusorial and diatomaceous earth (also called diatomite) is one of the important non-metallic mineral products of the State. It is widely distributed and production is on a competitive basis of quality, quantity and price. There are a number of deposits of this material in Sonoma County which are of economic value if they can survive the competitive market.

Goodman Bros. Deposit (Collings Deposit). This deposit, which has been known for years is in Sec. 10, T. 8 N., R. 8 W., one mile north of Mark West Springs and six miles east of Windsor, on the Northwestern Pacific Railroad. Owner, Goodman Bros., Box 213, Route 5, Santa Rosa, Cal.

The diatomaceous shale belt here has been traced for several miles, but it is only on the Goodman Ranch that the pure white diatomaceous earth is found. The bed averages about 12 feet in thickness and has been uncovered for 1500 feet. The material appears to be pure and high-grade. There has been no activity since a small tonnage was shipped in 1913.

Mt. Pisgah Vineyard Deposit. This is on the Goldstein Ranch in Sec. 30, T. 6 N., R. 5 W., two miles northeast of Agua Caliente. Considerable work was done here in 1922 and 1923 by the American Minerals Company in stripping the deposit, which averages 15 feet in thickness, but the company did not get into production. Idle.

Bibl: State Mineralogist's Report XIV, p. 322.

GEM MATERIALS.

Garnets, of two varieties, are found in Sonoma County. Almandite (iron-alumina garnet) occurs in chlorite schist three miles west of Healdsburg, notably on the Cox Ranch. Grossularite (lime-alumina garnet) also occurs in schist near Petaluma, in the vicinity of Gualala, at Camp Meeker and near Healdsburg. Some of the crystals are fully an inch in diameter, but they are not of gem quality. Their most likely commercial utilization would be as an abrasive.

Opals of gem quality and a fair play of 'fire' have been found in association with the clay deposit on the Weise Ranch, between Glen Ellen and Kenwood. A few have been cut and sold. J. H. Weise, Glen Ellen, owner.

C. A. Perry, of Healdsburg, has produced over 100 'Sonoma diamonds' from a deposit a short distance north of Healdsburg, discovered by him in 1917. The stones are in reality rock crystal (quartz) and occur in a hard formation resembling a burnt clay or shale. Only a small proportion of the crystals are perfectly transparent, white and flawless. They are usually cut like a diamond or in what is known as the Twentieth Century diamond cut which contains a larger number of facets.

Bibl: State Mineralogist's Reports IV, pp. 99, 182; VI, part I, p. 91; XIV, p. 320; Bull. 37 p. 52.

GOLD.

Traces of gold have been found at several places in Sonoma County, and a few colors can be obtained in some of the creeks by panning. Nothing of consequence has ever developed.

Bibl: State Mineralogist's Report XIII, p. 436.

GRAPHITE.

There was a small output of graphite from Sonoma County about 25 years ago, but no activity in recent years, although the mineral occurs at several localities.

McPherson Ranch Deposit. There is a deposit of graphite of fair quality on this ranch in Secs. 13 and 14, T. 9. N., R. 10 W., $3\frac{1}{2}$ miles west of Healdsburg. The material is suitable for stove polish, foundry facings, and paint manufacture. By washing and concentrating, a good quality of graphite could probably be produced. Idle.

Skinner Ranch Deposit. This deposit is in Sec. 14, T. 4 N., R. 7 W., four miles south of Petaluma, on the San Rafael road. Several hundred tons have been shipped from here in the past. Idle.

Graphite occurs on Porter Creek in T. 8 N., R. 10 W., in association with a deposit of red ochre (hematite). Undeveloped. It also occurs in the form of graphitic schist, two miles west of Cazadero. W. Porter Barnes, of Cazadero, has submitted samples from that locality. Specimens have also come from the Pine Flat district.

Bibl: State Mineralogist's Reports VI, part I, p. 111; XIV, p. 321; Bull. 38, p. 281.

IRON.

There are indications of iron ore along the second ridge back from the shore line, beginning about six miles east of Fort Ross and continuing northwesterly into Mendocino County. The more important localities are:

Hooper Ranch, J. W. Hooper, owner, five miles north of Nobles.

Lancaster Ranch, W. M. Richardson, Plantation House, owner; east of Fisk's Mill. Both yellow ochre and hematite occur. Some of it is siliceous, and suitable for paint.

Fort Ross, a large body six miles east of Fort Ross.

Bibl: State Mineralogist's Report IV, p. 182; XI, p. 461; Bull. 38, pp. 304, 365.

LIMESTONE AND MARBLE.

Black Ranch Quarry. This deposit is six miles north of Geyserville on Little Sulphur Creek. A little lime was burned here in 1906-1907, but no work has been done since.

Bibl: State Mineralogist's Reports XII, p. 396; XIII, p. 633; XIV, p. 323; Bull. 38, p. 93.

C. A. Perry, Healdsburg, has an option on a deposit of limestone situated about $3\frac{1}{2}$ miles west of Healdsburg. The following analysis was made by Thomas Price and Son in 1906:

	Per cent.
Calcium carbonate -----	93.45
Magnesium carbonate -----	1.22
Ferrous carbonate -----	1.13
Alumina -----	1.96
Manganese oxide -----	0.18
Silica -----	1.59
Organic matter -----	0.28
Loss and undetermined -----	0.23
	<hr/> 100.04

They reported the limestone to be well adapted to the manufacture of portland cement.

Shale and clay suitable for use with the above limestone are found in close proximity. The result of an analysis of the shale was as follows:

	Per cent.
Silica -----	41.52
Alumina -----	25.07
Ferrous oxide -----	3.15
Ferric oxide -----	10.05
Manganese oxide -----	0.38
Calcium carbonate -----	7.66
Calcium silicate -----	3.50
Magnesium oxide -----	1.12
Alkalies -----	0.98
Combined water -----	6.50
Loss and undetermined -----	0.07
	<hr/> 100.00

The clay showed the following composition:

	Per cent
Silica -----	55.08
Ferrous oxide -----	3.15
Ferric oxide -----	2.19
Manganese oxide -----	Trace
Alumina -----	20.14
Calcium oxide -----	3.86
Magnesium oxide -----	1.21
Alkalies -----	1.20
Combined water -----	12.25
Loss and undetermined -----	0.92
	<hr/> 100.00

It is stated that cement manufactured from the above raw materials would probably be of a light gray color.

There is a large deposit of limestone in Secs. 1 and 2, T. 9 N., R. 12 W., 15 miles west of north from Cazadero. It is stated to be traceable for a mile in length, and in places up to 300 feet in width. It could be used for building stone or for cement manufacture. It is a hard, fine-

grained, compact limestone, red, white, and cream-colored. The deposit was at one time located by the Healdsburg Marble Company but abandoned on account of being too far from a railroad.

MAGNESITE.

There are numerous deposits of magnesite in the county, some of which are in the district around Cloverdale, and another group is situated northwest of Guerneville in a belt of serpentine which strikes northwestward through T. 8 N., R. 10 W., and T. 9 N., R. 11 W. These deposits are described in detail by Bradley¹. As none of the properties are operating, they were not visited by the writer, and those interested in investigating the magnesite deposits are referred to the bulletin mentioned and other publications listed in the bibliography. The more important deposits are:

Albertz Ranch Deposits. Two miles southwest of Cloverdale. Some production has been made here.

Battenburg Magnesite Mine (also Creon or Kolling Deposit). In Sec. 32, T. 12 N., R. 10 W., three miles east of Preston Station. Several thousand tons have been produced here and the deposit is thought to be pretty well worked out. All equipment at the calcining plant has been removed. The Refractory Magnesite Company is out of existence and the present ownership of the property uncertain.

Burgens Ranch Deposit. One mile north of the Battenburg on the same ridge. Only stockwork and float found so far.

Madeira Deposit (Healdsburg Marble Company). In the southwest corner of Sec. 31, T. 9 N., R. 10 W., 5½ miles north of Guerneville. Patented property. Idle.

Meeker Ranch Deposit. Is in Sees. 2 and 3, T. 8 N., R. 11 E., seven miles by road north of Guerneville. Idle.

Melville Ranch Magnesite (Eckert Ranch; also Yordi Ranch). This deposit is two miles southeast of Cloverdale and was mined spasmodically for a number of years. Idle since 1918 or 1919.

Snyder Ranch Deposit. An undeveloped deposit on the George Snyder Ranch on Piney Creek, about 12 miles northwest of Healdsburg.

Sonoma Magnesite Company (Red Slide Deposits). This group includes some 30 claims on East Austin Creek in Sees. 6, 7, 8, 17, and 20, T. 9 N., R. 11 W., six miles north of Cazadero. A 24-inch gauge railroad eight miles in length, was built in 1914, extending from the narrow gauge line of the Northwestern Pacific Railroad to within three miles of the camp. The deposits were worked for over two years. In 1924 the property was taken over by Spreckels Bros., of San Diego, with a view to using the material in the manufacture of a patent wallboard, but operations soon ceased. It is stated that the magnesite here carries too high a percentage of silica to be suitable for plastic use. Title to the property is now said to rest in the National Magnesite Products Corporation, the mines and equipment having been sold at public auction in 1922 under a judgment held by the latter company.

¹ Bradley, Walter W., Magnesite in California, Cal. State Min. Bur. Bull. No. 79, 1925.

Western Carbonic Acid Gas Company. This company's group of claims is at the head of Gillian Creek in Sec. 6, T. 8 N., R. 10 W., seven miles north of Guerneville. A calcining plant was constructed at Guerneville in 1917, but very little ore has been produced.

Bibl: State Mineralogist's Reports XIV, pp. 324-333; XVII, p. 249; Bull. 38, pp. 331-333; Bull. 79, pp. 89-97; U. S. Geol. Survey Bull. 355, pp. 22-28; Bull. 540, pp. 480-498.

MANGANESE.

A few hundred tons of manganese ore were marketed during the World War from deposits in this county, but very few deposits of good grade and workable size have been found to date, the manganese usually occurring only as stains and small pockets in jasper. Most of the occurrences so far developed are described in Bulletin 76, *Manganese and Chromium in California*, 1918.

Shanks and Capps Lease. This property is located nine miles west of Geyserville, and two miles east of Skaggs Springs. It was in active operation during the World War and produced approximately 1000 tons of ore, reported to average 42% to 50% metallic manganese and 4% to 14% silica. There is stated to be considerable ore still remaining, but the mine has been idle since 1920.

Shaw and Mathews Mine. Is in Sec. 31, T. 12 N., R. 11 W., seven miles northwest of Cloverdale. It was opened up about 40 years ago, but remained idle until 1918, when it was leased and a little work done. The ore appears to be too low grade to be profitably handled.

There is a manganese prospect on the *C. C. Foss* ranch in Sec. 19, T. 11 N., R. 8 E., about one mile above The Geysers. Undeveloped.

Other occurrences have been noted at Pine Flat.

At Skaggs Springs there are extensive outcrops of red jasper stained with manganese and low-grade manganese and iron probably form a large portion of the precipitous mountain on the Skaggs Springs property.

Aho Ranch Deposit. The most recent activity in manganese mining has been on a group of deposits located about seven miles from Cazadero, near the summit on the road from Cazadero to the coast. The principal one is known as the *Drum Manganese Mine*. It has been worked intermittently by various lessees. Good-size lenses, up to six and eight feet in width, have been found. The last shipment of about 80,000 pounds was made by C. P. Seaburg in June, 1926. The manganese is on a ranch recently purchased and now owned by Matt Aho. The owners are continuing development, storing the ore on the dump for future shipment.

J. E. Hayden, of Cazadero, has a deposit in this section also.

Bibl: State Mineralogist's Reports IV, p. 316; XII, p. 330; XIII, p. 507; XIV, p. 333; Bull. 38, p. 337; Bull. 76, pp. 82-83; U. S. Geol. Survey Bull. 427, p. 163.

MINERAL PAINT.

Red and yellow ocher (hematite and limonite) mineral paint pigments were produced here for several years, but none has been mined for a decade or more.

Healdsburg Paint Company Deposits. This property, known and operated in the past under various names, is on Porter Creek in T. 8 N., R. 10 W., ten miles by road southwest of Healdsburg. The material is a low-grade hematite, high in silica.

Bibl: State Mineralogist's Reports XI, p. 462; XII, p. 406; XIII, p. 643; XIV, p. 333; Bull. 38, p. 340.

Meeker Ocher Deposit. This deposit is an ocherous clay in Sec. 21, T. 7 N., R. 10 W., $1\frac{1}{2}$ miles north of Camp Meeker. Some of this material has been shipped, but none within the last 10 or 15 years.

Bibl: State Mineralogist's Report XIV, p. 334; Bull. 38, p. 340.

Occidental Deposit. An undeveloped deposit of ocherous clay just west of the hotel at Occidental.

A small deposit of soft red hematite at Mark West Springs has been utilized locally for painting.

Samples of limonite (yellow ocher) have also been received from W. M. Jacobs, Pine Flat; I. Sutherland, Kellogg; and L. Renari, P. O. Box 149, Santa Rosa.

MINERAL WATER.

Sonoma County, like its neighbors, Lake, Napa, and Mendocino counties, has a large number and variety of mineral springs. Some of these are well known, and have a world-wide reputation. They vary in character and composition from the cold seltzer of Lytton's to the boiling hot waters and steam vents of The Geysers. Most of them are well equipped with comfortable hotels and cottages, and are fairly accessible to transportation lines. Sonoma County is one of the 'play-grounds' of California and many of the summer resorts are located around these mineral springs.

Agua Caliente Springs. T. H. Corcoran, Agua Caliente, owner. These springs are at Agua Caliente on the Northwestern Pacific Railroad, $2\frac{1}{2}$ miles northwest of Sonoma; elevation 131 feet (Northwestern Pacific). It is stated that originally the hot spring here was merely a mud hole used for many years by the Indians. The present owner has drilled six wells, and put in a large swimming tank, a bath-house, and a bottling works. The water is pumped, though it is stated that in the winter the wells have a small artesian flow.

The water pumped to the swimming tank shows a temperature of 102° F. at the pump (two wells combined, one of which is said to be warmer than 102°). The well from which water is bottled shows a temperature of 95° F. at the pump, and is discharged into a tank to cool before bottling. Electric power is used, and there is an auxiliary gasoline engine for emergency use. There is a capping machine, carbonator and mechanical labeler. There are accommodations for 300 guests in the hotel and cottages.

Bibl: State Mineralogist's Reports XI, p. 458; XIII, p. 521; XIV, p. 334; U. S. Geol. Survey Water Sup. Paper 338, p. 113.

Alder Glen Springs. A. Paridi, lessee. These springs are in Sec. 3, T. 11 N., R. 11 W., three miles northwest of Cloverdale; elevation 525 feet (bar.). McCray Station on the Northwestern Pacific is the railroad point. The springs are in serpentinized sandstone, and the four principal ones have the following temperatures: Surphur, 58° F.;

Magnesia, 56°; Soda, 57°; Iron, 57°. The hotel and cottages are picturesquely situated in a beautiful canyon of alders, redwoods and oaks.

Bibl: State Mineralogist's Report XIV, p. 335; Anderson, Winslow, 'Mineral Springs and Health Resorts of California,' p. 76; U. S. Geol. Survey Water Supply Paper 338, p. 166.

Altamont Springs. A lightly mineralized spring in Sec. 34, T. 7 N., R. 10 W., at Occidental on the Northwestern Pacific Railroad.

Barcal Spring. Barcal Water Company, operators; J. Kolling, Preston, manager. This calcic-magnesian spring is near the Kolling magnesite deposit in Sec. 32, T. 12 N., R. 10 W., about two miles east of Preston on the Northwestern Pacific Railroad at an elevation of 1375 feet (bar.). They have been bottling for about 20 years past, originally at the spring itself, but now the water is piped 9000 feet to the works at Preston Station. Electric power is used and three men are employed. The product is put up both carbonated and natural, and is used in the manufacture of various soft drinks. A new bottling machine has just been installed. There is no resort in connection with this spring. Nearby there is also an iron spring, but not utilized.

Boyes Hot Springs (at one time called *Agua Rico*). Owned by Sonoma Properties Company. Fred F. Partridge and R. G. Lichtenberg, managers. The post office and railroad station are both named Boyes Springs. It is two miles northwest of Sonoma; elevation 129 feet (Northwestern Pacific).

Water is obtained from both springs and wells. It is pumped to tanks to give pressure for the bathhouse use, and also pumped to the bottling works, where it is cooled before bottling. Electric power is used. The bottling is done under lease from the company. All of the production is carbonated. There is a fine large swimming pool with water at 80° F. and a hot plunge, both in a well-appointed bathhouse. The old hotel burned down in 1923. The Sonoma Properties Company, which has recently taken over the Boyes Springs property, expect to have a new 100-room hotel completed in 1927. A café seating 300, open to the public, and an 18-hole golf course are included in their plans.

Bibl: State Mineralogist's Reports XI, p. 458; XII, p. 347; XIII, p. 521; XIV, p. 335; U. S. Geol. Survey Water Supply Paper 338, p. 112.

Burns Springs. These springs are on the Hathaway ranch, three and one-half miles east of Glen Ellen. Not utilized except by the owners.

Bibl: State Mineralogist's Reports XII, p. 347; XIII, p. 521; XIV, p. 336.

Chimney Rock Spring. A sulphur water spring at the corner of Secs. 26, 27, 34, 25, T. 8 N., R. 11 W., six miles west of Guerneville, close to Chimney Rock, a natural topographic feature.

Bibl: State Mineralogist's Report XIV, p. 336.

Fetters Hot Springs. George Fetters, owner. This resort at the post office of the same name is between Boyes and Agua Caliente springs in the warm water belt extending northwesterly from Sonoma. Elevation 124 feet. There are three wells, stated to be artesian in winter, the first one of which was drilled in 1908. The warm water was struck at a

depth of 300 feet. It is pumped, using electric power, to a tank for swimming and the bathhouse. The temperature of the two principal wells are given as 114° F. and 90° F.

Bibl: State Mineralogist's Report XIV, p. 336; U. S. Geol. Survey Water Supply Paper 338, p. 114.

Hoods Hot Springs. Comprises two springs of small flow in the canyon of Dry Creek, 15 miles northwest of Cloverdale. Only used locally. Temperature 100° F.

Bibl: State Mineralogist's Report XIV, p. 336; U. S. Geol. Survey Water Supply Paper 338, p. 82.

Iron Spring. M. Gross, owner. Situated opposite Agua Caliente and Fetters. There is one cold spring said to be mineralized with iron and sulphur. Used for drinking only. There are hotel accommodations for 50 people.

Kawana Springs (formerly *Taylor's White Sulphur Springs*). These springs are in Sec. 36, T. 7 N., R. 8 W., 2½ miles southeast from Santa Rosa; elevation 276 feet (bar.). The principal spring has a temperature of 57° F.

Bibl: State Mineralogist's Reports VI, Pt. I, p. 75; X, p. 676; XIV, p. 337; U. S. Geol. Survey Bull. 32, p. 209; Water Supply Paper 338, p. 256; Anderson (op. cit.).

Kenwood Springs. Audrey Elston, owner, Kenwood. These springs, which are cold and said to contain magnesia and iron, are located 1½ miles northeast of Kenwood on Sonoma Creek. The water is used for drinking. A swimming tank is supplied from the creek. There is a small hotel, cottages and camp ground, which will accommodate about 100 persons.

Mark West Springs. Bertha Munger Seberg, owner. These well known springs are in Sec. 14, T. 8 N., R. 8 W., 10 miles north of Santa Rosa, from which city they are reached by automobile stage; elevation 450 feet (bar.). The warm springs are on the edge of Mark West Creek. The following temperatures have been observed: Bath Spring, 93° F. (strong flow); Magnesia, 90°; 'Plunge,' 92° (has excess gas); Sulphur, 90°; Arsenic, 65°; two, iron 58° each; one, iron 54°; two 'iron' across creek from others, 67°. The Bath Spring water, when a higher temperature is desired, is heated artificially.

The hotel, which has been recently modernized, cottages, and tents will accommodate about 150 guests. One picturesque feature of this resort is the large wild grape arbor in front of the hotel. There are eleven trunks up to 8 inches in diameter, which are twined around the porch posts, and the vines spread out on the arbor frame over the driveway.

Bibl: State Mineralogist's Reports VI, Pt. I, p. 75; VIII, p. 634; XII, p. 347; XIII, p. 522; XIV, p. 337; U. S. Geol. Survey Bull. 32, p. 206; Water Supply Paper 338, p. 115; Anderson (op. cit.).

On the *James O'Brien Ranch*, one mile northwest of Sea View, in Sec. 7 T. 8 N., R. 12 W., there is a cold mineral water well. It is at the station on the stage road west from Cazadero.

O'Donnell's Sulphur Spring is near Glen Ellen.

Ohms Springs—a drilled well one-half mile southeast of Boyes Springs. A small resort.

Bibl: U. S. Geol. Survey Water Supply Paper 338, p. 113.

Salvation Army's Boys and Girls Industrial Home and Farm (inc.) (formerly Lytton Springs; also Golden Gate Orphanage); post office, Lytton. These springs were originally and for many years known as Lytton Springs. The property is now maintained as an orphans' home by the Salvation Army. There are two principal springs, with the following temperatures: Soda, 64° F.; Seltzer, 62°. The soda spring is at an elevation of 425 feet (bar.), or 200 feet higher than the 'seltzer' and one-half mile distant. Water is free to the public. It is no longer bottled.

Bibl: State Mineralogist's Reports VI, Pt. I, p. 74; VIII, p. 634; X, p. 675; XII, p. 347; XIII, p. 522; XIV, p. 338; U. S. Geol. Survey Bull. 32, pp. 205-206, 211; Water Supply Paper 338, p. 165; Anderson (op. cit.).

Skaggs Hot Springs. Peter J. Curtis, owner, Skaggs. This group of well known hot springs is on Warm Spring Creek in Secs. 23 and 24, T. 10 N., R. 11 W., nine miles west of Geyserville. It is easily reached by good road from the State highway. The springs have been used as a resort since 1857. The present owner bought the property in 1913.

There are three principal springs with good strong flows, and all have an excess of carbonic acid gas and are notably free from sulphuretted hydrogen. The following temperatures have been recorded: 124°, 125° and 130° F. There is an exposure here of the older sedimentary (possibly cretaceous) rocks, including sandstone and shale from which the springs issue. Waring¹ states "The water at Skaggs is not perceptibly sulphuretted, but it has a distinct oily odor and taste." The above quotation is of interest, as a well put down for water in 1922 developed considerable quantities of inflammable gas and traces of oil of high gravity and paraffine base. Gas was also found issuing from the ground in the hillside back of the hotel and a short tunnel developed a supply which was ignited and burned for several months. A chemical analysis showed:

	Per cent
Carbon dioxide -----	6.7
Illuminants -----	.4
Oxygen -----	5.3
Hydrogen -----	nil
Carbon monoxide -----	nil
Methane -----	33.9
Ethane -----	2.9
Nitrogen -----	50.8

Its heating value was calculated to be 423 B.t.u. per cubic foot.

These developments led to the drilling of a well by the *Skaggs Springs Oil and Gas Company*, and a hole was put down to a depth of 400 feet. Considerable gas was developed and a strong flow of pure water. Drilling has not been carried farther up to the present time, although

¹ Waring, Gerald A., Springs of California, U. S. Geol. Survey Water Supply Paper 338, p. 81, 1915.

the formations are considered favorable for the production of high gravity oil in small quantity from a comparatively shallow depth. During the preliminary investigations it was found that some of the sandstone strata are heavily impregnated with arsenic in the form of realgar. While not considered an extensive deposit at first, this formation has recently been traced across the creek and the arsenic-bearing sandstone shown to extend at least $\frac{1}{4}$ mile in length. Associated with the realgar in the same sandstone stratum is what apparently is a new mineral heretofore unknown and tentatively named Curtisite in honor of the discoverer, Peter Leo Curtis. The mineral is found in the form of a greenish yellow coating and filling of seams in the rock. It is a natural hydrocarbon compound, the exact nature and composition of which has not been fully determined. Research work on it is being done in the laboratory of the U. S. Geological Survey.

A large swimming tank is supplied by the combined overflow of all the mineral springs. The hotel, cottages and tents will accommodate 250 guests.

The Geysers. Owner, Geysers Development Co.; J. D. Grant, president, Healdsburg, California; R. B. Kidd, manager, The Geysers. Prior to 1921, 'The Geysers' of Sonoma County, formerly owned for many years by D. and H. A. Powell, of San Francisco, meant simply another mineral spring resort, but one famous for its scenic features, boiling hot springs, fumeroles, and steam vents. The locality is said to have been first brought to public notice in 1847, and it has been of more or less scientific interest ever since, although there are no true geysers (spouting high into the air), as the name infers. It has been a resort for more than a half-century, and has been visited by many internationally known personages, including General Grant, Mark Twain, Horace Greeley, J. P. Morgan, and Edward the VII, of England.

These springs are situated in the northern corner of Sonoma County in Sec. 13, T. 11 N., R. 9 W., 18 miles east of Cloverdale; elevation 1450 feet at the hotel. The geysers themselves are a series of boiling hot springs in two short tributary canyons on the north side of the rugged canyon of Big Sulphur Creek, one time called the Pluton River. The Little Geysers, an area of similar character but much less extent, is situated about 3 miles above here, on the same creek.

The ebullition in many of the springs is so violent that the water is projected a short distance. Deposits of sulphur, iron sulphide, epsomite, and other salts and minerals are continually forming around the vents, the result of deposition from the vapors and disintegration of the rocks. Below, on the edge of the main creek, there are other mineral springs known as 'White Sulphur,' 68° F.; 'Hot Sulphur,' 100°; Hot Iron, 130°, and Hot Magnesia, 143°. Water and steam from the springs is piped across the ravine and supplies the bathhouse and vapor baths. Steamboat geyser is a steam vent a little east of the main group in another ravine. It has a temperature of 212°.

The mineral waters here form a remarkable series, containing sulphates, carbonates, silicates, and borates of potassium, sodium, magnesium, calcium, iron, and aluminum. Gases from the steam vents (and wells drilled in the fumarole area) have been shown to be radioactive¹.

¹Bradley, Walter W., Radioactivity in Thermal Gases at The Geysers, Sonoma County, California. State Mineralogist's Report XVIII, pp. 545-550, 1922.

The rocks in this area consist of broken and much altered sandstone and shale with cherts, schist and associated bodies of serpentine.

Because of the adjacent quicksilver districts, these hot springs have been much described and discussed in relation to the association of hot springs with the genesis of quicksilver ores.

Since 1920, when John D. Grant, of Healdsburg, took a lease and option on the Geysers property, it has become the center of interest of a new steam power development project. Besides making improvements at the bathhouse and hotel, Mr. Grant conceived the idea of developing steam for the generation of power and began drilling a well in the summer of 1921. This well was not completed, as the casing collapsed. A second well called No. 1 was put down with 12-inch casing to 105' then an 8-inch casing inside of that down to 118', after which the hole was drilled in rock without casing to its final depth of 204'. At this depth a crevice was broken into (27 such crevices were passed in drilling



Close up view of No. 1 and No. 2 steam wells, the first two drilled.
The Geysers, Sonoma County.

between 124' depth and the bottom), and the pressure developed was so great that drilling was suspended. It was the gases from this well that were tested for radioactivity by Bradley¹ in 1922. At that time, with the top valve closed and the valve in the 8-inch horizontal pipe wide open, the steam gauge at the well showed 60 pounds pressure. With both valves closed the gauge registered 70 pounds. A Brown expansion pyrometer indicated a temperature of 530° F. within the chamber of the top gate-valve while discharging wide open.

The encouraging results led to the organization of the Geysers Development Company, which now owns several thousands acres, including 'The Geysers' proper, located about the center of the 'heat belt,' the Little Geysers, at the eastern end of the belt, and practically all of the adjoining area showing thermal activity. This heat belt extends for six miles along the main canyon and steam is in visible evidence at five distinct localities.

¹ Bradley, Walter W. (op. cit.).

**Development of Natural Steam Wells for Power Purposes
at 'The Geysers.'**

The work carried on by the Geysers Development Company for this most unusual project (the only one known outside of that at Larderello, Italy) is described in a paper by Mr. J. D. Galloway¹, consulting engineer for the Company. Mr. Galloway kindly permitted the writer full use of his manuscript in preparing the following notes:

Geology.

A geologic reconnaissance was made by Mr. L. C. Decius, geologist. Mr. Decius conceives the canyon of Sulphur Creek to be a major fault extending for many miles southeastward, and the reason for the existence of the fumeroles and hot springs at The Geysers to be a weakened fractured zone or fault through which both magmatic and meteoric waters find their way to the surface; the magmatic waters from the earth's centrosphere and the meteoric waters from a maximum depth of $6\frac{1}{2}$ miles to which they may possibly percolate downward. His conclusion is that the fumeroles have their origin in the molten mass of the earth's magma, the heat being transmitted to the surface by steam and other vapors escaping through the fractured fault zone, and that there is no reason to expect the cessation of the escape of the magmatic vapors.

The Wells.

Well No. 1 was commenced in 1922 and completed to its final depth of 204 feet in September of that year. Well No. 2 was started October 17, 1922, and completed to a depth of 320 feet on July 20, 1923. Well No. 3 was begun in the summer of 1924 and was down 150 feet when work was stopped. Wells No. 1 and No. 2 are cased with 8-inch casing. The first three wells were drilled with a light Keystone churn-drill rig. The steam coming into the wells during drilling was controlled by a stream of cold water poured into the well. This water was blown out of the wells at intervals of half an hour or so by the geyser action of the steam.

In May, 1924, Mr. Galloway made tests of the amount of steam coming from wells No. 1 and No. 2 by steam flow meters. The static pressure on these two wells was then 62 pounds per square inch. Their flow warranted the drilling of more wells to prove the extent of the steam area, and arrangements were made by the company with the Diamond Drill Contracting Company to drill more test wells. A rotary drill rig with special arrangement for control of the steam pressure by circulating water was installed and during the first seven months of 1925 five wells of the later series of tests, No. 4, No. 5, No. 6, No. 7 and No. 8 were drilled.

The first four wells in this series are of the same size and type and are distributed over an area about 550 feet long. An open hole is first drilled through the overburden and into rock as far as possible. Into this hole a ten-inch wrought-steel casing is set and the space between casing and the walls of the hole filled with portland cement grout. After the cement is set, the hole is drilled deeper into the rock until the flow of steam is good and then an inside eight-inch wrought-

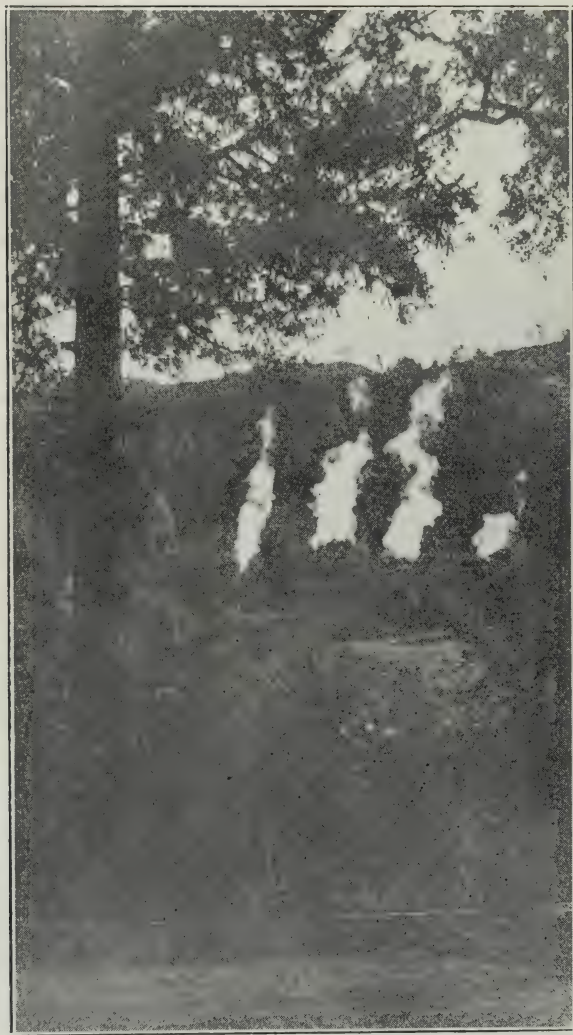
¹ Civil Engineer, First National Bank Bldg., San Francisco.



Four steam wells discharging. From left to right, No. 7, No. 6, No. 5 and No. 4. Taken October 16, 1925.
The Geysers, Sonoma County. Photo by courtesy of J. D. Galloway.



Steam well No. 5 discharging. The Geysers, Sonoma County.
Photo by courtesy of J. D. Galloway.



Distant view of steam wells at The Geysers, looking across Big Sulphur Creek Cañon from the Hotel. Taken in August and with wells discharging into the ground to muffle the roar of escaping steam.

steel casing inserted and the space between the two casings is filled with cement grout which is allowed to set. After this the well is drilled as an open hole deeper into the ground. The following is a tabulated statement of the conditions of wells No. 4, No. 5, No. 6, and No. 7, with some figures for No. 8 now drilling:

TABLE NO. 1.

	No. 4	No. 5	No. 6	No. 7	No. 8
Depth of 10" casing-----	153'	91'	83'	103'	68' (15")
Depth of 8" casing-----	256'	203'	208'	176'	160' (12")
Depth to bottom of well-----	451'	416'	487'	483'	---

The successful results of these wells led to plans for drilling larger wells, and it will be noted that well No. 8 has a 15" outside casing and a 12" inside casing. This latter well is not yet completed.

In drilling the wells, the incoming steam is condensed by a stream of cold water pumped down to the bottom of the well through the interior hole of the drill stem. The water is sent down under pressures up to 250 lbs. per square inch and under the pressure rises to the top of the well outside the drill stem and flows off through a side vent. A point is reached when the cold water sent down comes back heated to near the boiling point and this indicates about the depth required. All openings on the well are then closed and the drill removed. When all is clear, a valve at the top is opened and the hot water is blown from the well by the geyser action. Rocks and dust are also blown out and it takes a week or so before the discharge clears the passages.

The hardness of the rock varies greatly. The drill often encounters fissures or fumaroles in its passage downward and these underground fumaroles indicate the presence of steam.

The wells are very spectacular, especially in cold weather when the steam can be seen rising to a height of 500 feet or more. The steam escapes with a deafening roar from the wells when blowing off and for this reason must be diverted into the ground in order to muffle the sound, so that the drillers may work.

Characteristics.

The steam pressure, wells closed, varies, and the same is true of the quantity of steam discharged under different pressures. In the case of wells No. 6 and No. 7, the wells have not been closed long enough to indicate the maximum pressure, but it is believed that it will reach 300 pounds to the square inch. After well No. 6 was brought in with an initial closed pressure of about 250 pounds, the static pressure in other wells has become greater. The following table indicates this:

TABLE NO. 2.

	No. 1	No. 2	No. 4	No. 5	No. 6	No. 7
	lb.	lb.	lb.	lb.	lb.	lb.
Initial static pressure-----	64	67	82	143	240	198
Static pressure, September-----	67.5	67.5	107	211	276	---

The data for No. 7 are not complete, as there was no provision for allowing the large valves to be operated under the anticipated pressures.



Steam Well No. 6 in foreground discharging. Derrick over Well No. 9 in center. Well No. 5 in background discharging. Derrick over Well No. 8 in background. The Geysers, Sonoma County. Photo by courtesy of J. D. Galloway.

Tests.

Numerous tests of the quantity of steam flowing from the wells have been made. Steel discs $\frac{1}{16}$ " thick with circular openings of different diameters are clamped between flanges and the steam allowed to escape until such time as the pressure becomes constant for each disc. The edge of the opening in the disc is rounded to a knife edge from which the diameter is measured. Pressures are read by calibrated test gauges on a pipe tapped into the well casing a few feet below the orifice and the quantity of steam flowing determined by Napier's formula. The tests for quantity of steam made with disc openings of different diameters with resulting different pressures give a series of data for each well that may be plotted as a curve.

In making the tests for quantity of steam, it was endeavored to have the measurements taken after the well had been discharging for some time under pressures and conditions that would approximate those of an operating steam plant. There is a cumulative effect when the wells are closed for a period and the steam seems to fill crevices in the earth. When opened, if readings are taken immediately, a greater quantity of steam is indicated than when the well has blown off for a period. The data on well No. 4, seems to be a case in point, but the similar change in well No. 5 is not of the same order. Since No. 5 was opened there has been a steady increase in pressures and in quantity of steam produced.

A considerable difference in quantity and pressure of steam is found in the different wells. No. 1 and No. 2, which are some distance from the others and not so deep, stand at 62 pounds gauge pressure when closed. These wells are close together and undoubtedly connected. Wells No. 4, No. 5, No. 6 and No. 7, driven under supervision of Mr. Galloway in 1925, show wide differences. No. 4, No. 6 and No. 5 lie in a straight line in the order named, the distance between No. 4 and No. 6 being 275 feet and between No. 5 and No. 6 the same; No. 6 being midway between No. 4 and No. 5. The maximum static pressure for No. 4 is 111 pounds; of No. 6, 276 pounds, and of No. 5, 210 pounds. It is probable that if No. 4 were drilled deeper it would deliver greater quantities of steam and register greater pressures. Well No. 7, 160 feet distant from No. 6 at right angles to the line of the other wells, is somewhat larger than No. 6 and it is thought the static pressure of this well will reach 300 pounds. The highest yet reached is 276 pounds in No. 6. After the wells have been open for a time, and are then closed, the pressure rises rapidly. No. 6, opened for several weeks and discharging at about 150 pounds, rose to 270 pounds pressure in fifty minutes. However, after a well has been open, it takes several days to build up to the highest pressure recorded.

In practice, since the wells must deliver steam into a common header, the quantity of steam from each well will vary. If seventy-five pounds header pressure be assumed, then the four wells described will deliver the following quantities of steam per hour:

Well No. 4	7,500 lb.
Well No. 5	52,000 lb.
Well No. 6	38,000 lb.
Well No. 7	40,000 lb.
Total	137,500 lb.

With a water rate of 27.5 lb. per kilowatt-hour, condensing, these four wells represent a switchboard delivery of 4500 kw., after allowing 10% losses in steam in transmission. Each well on the average will thus deliver about 1000 kilowatts.

It will be noted that all the pressures given are gauge pressures.

The question might be asked why the wells are not drilled deeper, as the higher pressures and larger quantities are found at the lower limits of the wells. It can be answered that pressures up to 250 pounds and 300 pounds are high pressures. However, the principal reason for not going deeper is found in the nature of the ground through which the wells are drilled. It is naturally porous as shown by the surface vents. As the wells are only cased to a depth of about 200 feet, the higher pressure steam from the lower depths is brought in contact with existing fumaroles of the upper rocks, and it might tend to open up an escape through some fissure in the upper rocks. Again, the seal of the casing against the rock is not absolute, and there is danger of blowing out alongside of the casing or of blowing out the entire casing; such accidents having occurred in oil wells subject to high gas pressure. For these reasons it is believed that 300 pounds gauge pressure is as high as should be developed.

Gases.

From the experience gained at the steam wells at Larderello, Italy, it was anticipated that gases other than steam would be found mingled with the steam. There are numerous gases in the surface strata, but the steam from the wells shows a smaller percentage of gases than at Larderello. Tests of gases from Wells No. 1, No. 2, No. 3, and No. 4 have been made and the results are given in the following table:

TABLE No. 3.

Analysis of Steam.

(Per cent by volume.)

	Well No. 1 <i>Per cent</i>	Well No. 2 <i>Per cent</i>	Well No. 4 <i>Per cent</i>	Well No. 5 <i>Per cent</i>
Noncondensable gas—				
1st test -----	1.47	1.13	0.82	0.70
2d test -----	1.43	1.16	0.81	0.69
Average -----	1.45	1.14	0.82	0.70

Analysis of Noncondensable Gas.

(Per cent by volume.)

	<i>Per cent</i>	<i>Per cent</i>	<i>Per cent</i>	<i>Per cent</i>
Ammonia (NH ₃) -----	Trace	Trace	Trace	Trace
Hydrogen sulphide (H ₂ S) -----	2.60	2.70	2.80	2.80
Carbon dioxide (CO ₂) -----	66.60	67.30	67.20	68.20
Unsaturated hydrocarbons -----	Nil	Nil	Nil	Nil
Oxygen (O ₂) -----	0.20	0.30	0.30	0.20
Hydrogen (H ₂) -----	13.80	13.1	12.60	12.20
Carbon monoxide (CO) -----	Nil	Nil	Nil	Nil
Methane (CH ₄) -----	11.80	11.10	11.70	12.10
Ethane (C ₂ H ₆) -----	0.50	1.10	0.60	0.70
Nitrogen (N ₂)* -----	4.50	4.40	4.80	3.80
	100.00	100.00	100.00	100.00

* Including inert soluble gases, if present.

Analysis of Condensed Water.

(Volumes of gas per 100 volumes of water.)

Ammonia (NH ₃)	11.8	13.4	17.9	16.8
Hydrogen sulphide (H ₂ S)	3.4	3.4	4.7	4.2
Carbon dioxide (CO ₂)	14.9	15.0	15.2	15.1
Total dissolved gases	30.1	31.8	37.8	36.1

Analysis of Steam.

(Per cent by volume.)

	<i>Per cent</i>	<i>Per cent</i>	<i>Per cent</i>	<i>Per cent</i>
Noncondensable gases	1.45	1.14	0.81	0.70
Soluble gases	0.02	0.03	0.03	0.03
Steam (by difference)	98.53	98.83	99.16	99.27
	100.00	100.00	100.00	100.00

A question also arises as to the effect of these non-condensable gases in a condenser or to their effect upon a turbine if they are not removed. At Larderello, the plan at first adopted was to regenerate pure steam, using the natural steam in boilers, but the deterioration of the regenerative boilers was rapid. Later a degasifier was adopted which seems to have been more successful. At The Geysers some tests have been made on turbine blades of different metals and a small turbo-generator set containing blades of different metals has been operated on natural steam from Well No. 6. The engines of the drilling rig have used the steam for nine months with no trace of corrosion. So far the tests indicate that a metal for turbine blades can be made which the gases will not attack. It is to be noted in this connection that copper or alloys containing copper are quickly eaten away by the gases.

The problem of developing a steam plant at The Geysers has been considered and estimates prepared for condensing and non-condensing plants. If a condensing plant is used, cooling towers are necessary, as the flow of the stream in summer is not sufficient for the condensers. There seems to be no doubt that the problem presented by the non-condensable gases can be solved. The development of steam at high pressures from the ground by wells is an unqualified success, and the extent of the territory gives promise of a large development.

Bibl: State Mineralogist's Reports IV, p. 182; VI, Pt. I, p. 75; VIII, p. 635; X, pp. 672-675; XII, p. 347; XIII, p. 521; XIV, pp. 338-341; U. S. Geol. Survey Mon. XIII, p. 377; Bull. 32, pp. 204, 206; Water Supply Paper, 338, pp. 83-88; Anderson, Winslow (op. cit.); Geol. Survey of Cal. Geology, Vol. 1. Gallo-way, J. D., Paper.

Wall Spring. This is a magnesia spring in Sec. 30, T. 8 N., R. 9 W., northeast of Hilton.

Bibl: State Mineralogist's Report XIV, p. 341; U. S. Geol. Survey Water Supply Paper 338, p. 257.

In addition to the above, there are a number of small locally known warm and cold sulphur and magnesium springs of no economic importance at various localities in the county.

Bibl: State Mineralogist's Report XIV, p. 341; U. S. Geol. Survey Water Supply Paper 338, pp. 114, 258.

NATURAL GAS.

At several places in the vicinity of Geyserville, in the valleys of Sonoma and Petaluma creeks, at Skaggs Springs, and in the Petaluma district, where drilling for oil is now going on, more or less natural gas has been encountered in well-boring operations. There is no commercial production, although there is probably enough going to waste at Witt and Associates oil well in the Petaluma district to supply gas for drilling operations at one of the other wells, if a pipe line was put in. (See Petroleum.)

PETROLEUM.

The possibilities of oil production in Sonoma County are discussed by Vander Leek¹ in Bulletin 89, pp. 36-38. The evidences as to petroleum are stated as follows:

"On the Ducker ranch, three and one-half miles east of Petaluma and one and one-half miles east of the old adobe fort, in the bottom of a small canyon, there are seepages of a heavy black asphaltic oil in the blue sands of the San Pablo formation. These beds are apparently dipping at an angle of about 40° to the southeast. About 1909 four wells were drilled on the mesa just above the seepages. The Ramona Oil Company drilled three of the wells and the Petaluma Home Oil Company, one well. These holes have now been abandoned. Well No. 1 of the Ramona Oil Company was drilled in blue clay and brown sand to a depth of 800 feet, where it is claimed that gas was struck, which had a pressure of 217 pounds and a flow of 690,000 cubic feet per 24 hours. The well, however, soon clogged up and the flow ceased.

"Well No. 2 was drilled to a depth of 910 feet, logging oil sands at 335 to 400 feet. In none of these wells, however, was oil obtained in commercial quantities."

Undismayed by the failure of these wells to produce, renewed efforts have been made during the past few years, and a small production of oil is now being obtained in the Petaluma district. From January, 1922, to July 31, 1926, the following notices of intention to drill in Sonoma County, were filed with the Department of Petroleum and Gas of the State Mining Bureau:

<i>Year.</i>	<i>Company.</i>	<i>Location Sec. T. R.</i>	<i>Well No.</i>
1922	Sage and Olson	Miller Ranch	1
1922	Sage and Olson	Shoults Ranch	1
1923	Beach and Landini	4- 9- 9	1
1923	Edgar T. Wallace	{ Ducker Ranch	
		-- 5- 6	1
1923	Alexander Valley Oil Co.	--10- 9	1
1923	Skaggs Springs Oil & Gas Co., Inc.	24-10-11	1
1923	Skaggs Springs Oil & Gas Co., Inc.	24-10-11	2
1924	Alexander Valley Oil Co.	8- 9- 8	2
1924	Herbert N. Witt	-- 5- 6	2
1926	O. F. W. Drilling Co., Inc.	-- 5- 6	1
1926	Shell Co.	{ Lot 27 Rancho	
		{ Petaluma, Murphy	1

The last three are the only ones now active.

The Herbert N. Witt notice was filed in August, 1924, and in the latter part of 1925 H. N. Witt and associates completed and brought in their well on the Ducker Ranch with an initial flow of 19° Be. gravity oil at the rate of about 20 barrels per day. This output declined rapidly, however, to about one-half the initial flow. The well

¹Vander Leek, Lawrence, Petroleum Resources of California, Cal. State Mining Bur. Bull. 89, 1921.

PROPERTY MAP
OF THE
PETALUMA DISTRICT

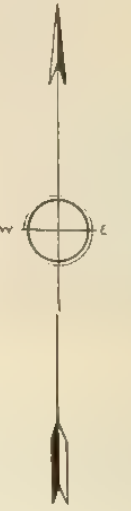
SONOMA COUNTY CALIFORNIA
COMPILED FROM OFFICIAL SOURCES BY
SONOMA COUNTY LAND TITLE CO

FOR
HNWITT AND ASSOCIATES INC.

SCALE

0 20 40 60 80 CHAINS

MAY 1, 1926.



PETALUMA

LEGEND

- H.N.WITT & ASSOCIATES
- SONOMA MINERAL CO.
- SHELL - WITT CONTRACT
- SHELL CO.
- ANSONIA OIL CO.
- OF W.DRILLING CO.
- H.GALE - GULF OIL CO.
- H.D.WILCOX
- MARLAND OIL CO.

is now on the pump and five to seven barrels per day are being recovered. The so-called Witt sand from which this oil is obtained was struck at a depth of 967 feet. This showing, which is one of the best so far developed in the northern counties, created considerable interest, and leasing of the surrounding territory and drilling by other operators soon began. At the present time the O. F. W. Drilling Co., Inc., is putting down a well, and the Shell Company is also drilling a test well, which will probably be a deep test to determine if there are other more productive sands below the Witt sand. The accompanying map¹ of the district shows the various leases and the location of wells now producing or drilling. The showing so far is encouraging, but the extent and productivity of the area is still undetermined. Aside from the three operators named no activity is going on at this time at the other locations for which permits to drill have been issued.

QUICKSILVER.

There is little that can be added to the detailed report on the quicksilver mines and resources of Sonoma County, contained in Bulletin No. 78 of the State Mining Bureau by Bradley², published in 1918.

Bradley describes the geology and ore occurrences in various parts of the county, lists all the mines, records their development and possibilities, and describes their metallurgical practice. His report also contains a geological map of the quicksilver district and a bibliography of publications referring to each individual mine and to the general subject in all its phases.

Quoting from the introductory chapter on Sonoma County's mines, Bradley says:

"The Sonoma County quicksilver deposits, particularly those of the Pine Flat district, are among the oldest known in the state. They vary in character from the ordinary, mainly cinnabar-bearing ores, and the less common meta-cinnabarite, to the purely native mercury type as in the Rattlesnake and the Socrates. This last named group is found in the Pine Flat district, southeast of The Geysers; and has proved so far the most difficult to handle both from a mining and a metallurgical standpoint.

"Prospecting and exploitation of the Pine Flat belt of deposits began in the early sixties and in 1861 some 33,000 feet of claims had been located on it³. Among the claims being worked in that year were the Cincinnati, Dead Broke, Pittsburg, Pioneer (later renamed Socrates), and Denver. Though small amounts of quicksilver were produced by a retort from the Pioneer's native mercury ore, the result was not profitable from a pecuniary standpoint. The first definitely recorded output of quicksilver in the county was from the Sonoma mine in the same district in 1873⁴.

"With the exception of the Great Eastern lode which is isolated from the other quicksilver deposits of this section of the state, the quicksilver mines of Sonoma County are located at the western end of what is known as the Mayacmas District, the general geology of which is described in a preceding section of the present report. The Cloverdale is the westernmost mine on this belt. The ore-bearing zone, which strikes southeast in the Cloverdale turns abruptly to the south at the Squaw and Buckeye claims, crossing to the opposite side of Big Sulphur Creek; then turning again runs south of east through the Esperanza mine, passing to the south of The Geysers, and continuing southeasterly through the Socrates mine in the Pine Flat section. In the Cloverdale, the dip is northeast at about 70°, east at the Buckeye, and southwest at the Socrates. While native mercury is a character-

¹ Map supplied through the courtesy of Sonoma County Land Title Co., Santa Rosa. Lease data furnished by Mr. J. I. Jewell, Santa Rosa.

² Bradley, Walter W., Quicksilver Resources of California, State Mining Bureau Bull. 78, 1918.

³ Whitney, J. D., Geol. Surv. of Cal., Geology, Vol. I, p. 89, 1865.

⁴ Raymond, R. W., Min. Res. West of the Rocky Mts., 1874, p. 30.

istic in the southeastern part of this zone, none is found in it north of Big Sulphur Creek.

"As will be noted from the table of production, there have been two principal periods of activity in the yield of quicksilver from Sonoma County mines previous to the present one, 1874 to 1883 and 1888 to 1906. From 1882 to 1894, the Great Eastern mine was the only producer."

The total recorded production of the county has been close to 75,000 flasks, valued at approximately \$3,500,000.

Bulletin No. 78 is still available and no attempt will be made at this time to give a comprehensive report on the quicksilver industry, partly because it is now dormant, and also because it would be a needless repetition of existing data. So far as the writer could learn, there is not at the present time a single producing property in the county. The most recent output came from the Cloverdale mine, but this mine shut down in September, 1925. There have been rumors of the re-opening of some of the properties, but so far no actual work has been started. A few of the more important properties will be briefly mentioned.

Buckeye Mine. Owner, C. A. Baumeister, Cloverdale. Located in Secs. 3 and 4, T. 11 N., R. 9 W.; adjoins the Cloverdale Mine.

Cloverdale Mine. Last operated by Balch and Gould. Idle since September, 1925. Subsequent to the publication of Bulletin No. 78, the Western Mercury Company, former owners, installed a rotary reduction furnace. A description of the equipment installed and its operation is given in State Mineralogist's Report XVII, pp. 250-252.

Culver-Baer Mine. Owned by the Culver-Baer Mining Company, C. E. Humbert, president, Cloverdale. A former good producer. Has been idle since 1919.

Great Eastern Mine. Owned by Great Eastern Quicksilver Mining Company, George Roeth, president, 450 Mountain Avenue, Oakland. This mine is credited with the production of the greater portion of the output of the entire county. The mine is in Sec. 16, T. 8 N., R. 10 W., four miles northeast of Guerneville. It has not been worked since 1919.

New Sonoma Mine. Property consists of a group of claims in the Pine Flat district in Secs. 4 and 5, T. 10 N., R. 8 W. Owned by the New Sonoma Quicksilver Mining Co., Inc. There has been some litigation over title to the claims. Idle.

Rattlesnake Mine. In Sec. 31, T. 11 N., R. 8 W. Native metal occurs in the ore at this property. Idle.

Socrates Mine. At the corner of Secs. 32 and 33, T. 11 N., and Secs. 4 and 5, T. 10 N., R. 8 W., in the Pine Flat district. The mine is equipped with a Scott furnace and has made considerable production. Much native metal occurred here, especially in the upper levels. Shut down in 1919.

Bibl: State Mineralogist's Reports I, p. 26; IV, pp. 338-344; VI, Pt. II, pp. 72-73; VIII, pp. 632-633; X, p. 675; XI, pp. 460-461; XII, p. 371; XIII, pp. 602-603; XIV, pp. 316, 342-351; XVII, pp. 250-252; Bull. 27; Bull. 78; U. S. Geol. Survey Mon. XIII; Mineral Resources, various years. For an extended bibliography, see Bulletin No. 78.

STONE INDUSTRY.

(Crushed rock, sand and gravel.)

These materials, and in former years paving blocks, designated in the trade 'basalt blocks,' and some building and curb stone have been one of Sonoma County's important mineral assets for many years. The majority of the paving blocks used in street work in the cities of the state have come from quarries in this county, but this character of paving is now little used, and many of the quarries have been closed down for the past ten years or more.

Most of the rock, particularly along the ridge above Rincon Valley, is andesite, though it grades into basalt, and in other places to trachyte.

Although the output of paving blocks and cut stone has practically ceased, there has been an increase in the output of crushed rock, gravel and sand, and the stone industry continues to be the most important contributor to the mineral output of the county.

More than fifty quarries are listed and described in Report XIV, 1913-14, although many of them were idle at that time. A description of these idle properties will not be repeated in this report, but the location of some of the more important ones will be given.

Cloutts Bros. Quarry. (Grace Bros.) Located one and one-half miles northeast of Kenwood station, the scarred side of the hill being plainly visible from the valley near Kenwood. It was last operated by Grant, Smith & Co. in 1923, who supplied rock for a paving contract. All equipment has been removed.

Bibl: State Mineralogist's Report XII, p. 397; XIII, p. 635; XIV, p. 355.

Craig Quarry. On a low rounded ridge, one and one-half miles northeast of Penn Grove. Idle.

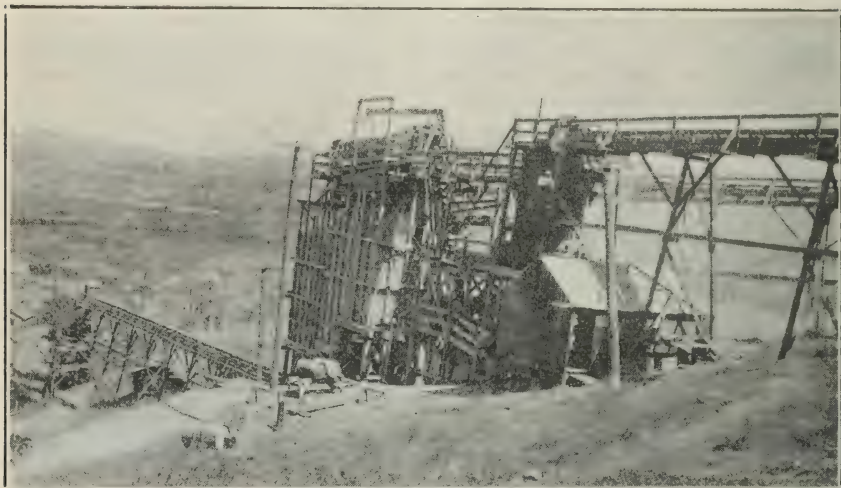
Fairville Quarry. Near Fairville on the Northwestern Pacific Railroad. Idle.

Gray Quarry. In Sec. 6, T. 7 N., R. 7 W., three miles northeast of Santa Rosa. Idle.

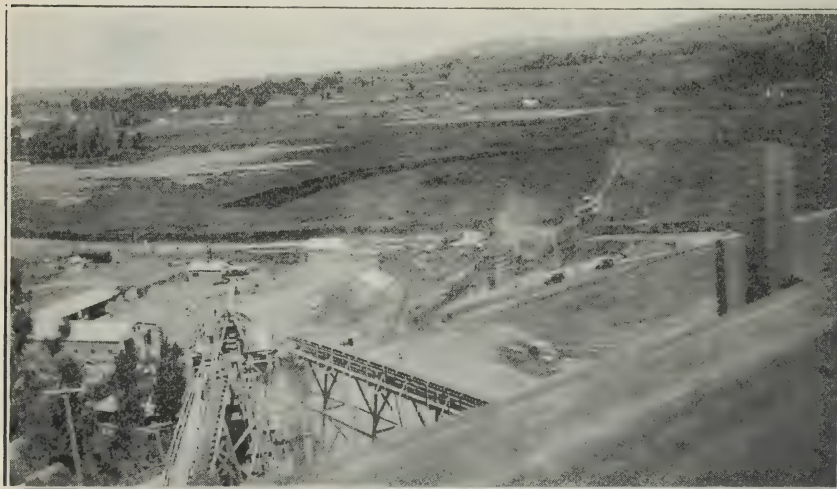
Hein Bros. Basalt Rock Company (formerly Hein Construction Co.). Mark Hein, president; G. W. Walters, secretary; home office, Petaluma. This property consists of 20 acres located one mile south of Petaluma, covering a deposit of hard blue-gray basalt adjacent to the old Petaluma Rock Quarry but operated from the opposite side of the ridge. Production of crushed rock began here in August, 1925. The quarry face is about 300 feet above sea level, but the finished product is delivered to barges on Petaluma Creek by a series of conveyors having a total length of 900 feet with four drops. The last section crosses over the state highway and Northwestern Pacific Railroad tracks. Bunkers are provided here for loading railroad cars. Another bunker discharges to trucks. Outside storage is also provided. On account of its long hillside construction feature, few elevators are required.

In the quarry jack-hammer drills are used, with down holes. The broken rock is conveyed by a drag-line scraper to a No. 13A Tel-smith gyratory crusher. The crusher discharge falls onto a 24" conveyor belt which delivers to a scalper screen of the shaker type, which

removes $\frac{1}{2}$ " material. The oversize goes to another screen that takes out 1" material, which goes by 20" belt to the stock pile or by the long conveyor system to the loading bunkers. The remaining oversize goes to a stock pile or by conveyor belt to the secondary crushing unit which contains one No. 4 and one No. 2 Telsmiths and an 8' by 20" rotary



General view looking down hill along line of screening and conveyor units at Hein Bros. Basalt Rock Company's Plant, Sonoma County.

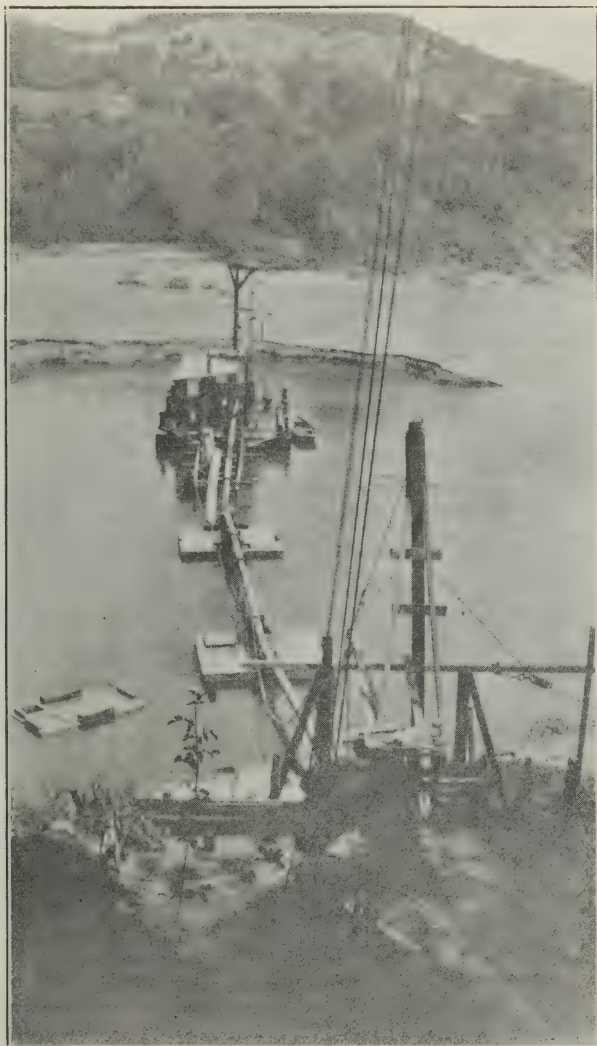


Lower end, showing in distance conveyor over highway and railroad, Hein Bros. Basalt Rock Company's Plant, Sonoma County.

screen delivering $\frac{1}{2}$ " to $2\frac{1}{2}$ " material as desired. The discharge goes to a bunker or onto the long delivery belt. Practically any size product desired can be produced and delivered to stock pile or loaded direct to barge, railroad car or truck. There is a pumping plant at the slough for washing. The entire plant is driven by electric power furnished by the Pacific Gas and Electric Company; 290 horsepower being used.

Ten men are employed, two in the quarry and eight in the plant, which has a capacity of 400 tons per day.

Helberg Gravel Plant. Fred Helberg, Schellville, owner. This plant is on Sonoma Creek, one-quarter mile from Schellville P. O. Gravel is taken from the creek bed with a drag-line hoist, using a



Sand and gravel pumping unit at Independent Sand and Gravel Company's Plant, Sonoma County.

LeClaire scraper. It is screened and the oversize crushed in a Tel-smith gyratory. The following sizes are produced: 2" to 1"; 1" to $\frac{3}{4}$ " and $\frac{3}{4}$ " to dust. All of the material is washed by water pumped from the creek. Electric power is used, the connected load being 53 horsepower. Two men, with the owner, operate the plant.

Hagermann Gravel Pit. This is a small plant owned by Ed. Hagermann, Schellville. It is located on Sonoma Creek, one-quarter mile from Schellville P. O. Gravel is taken from the creek bed and screened to various sizes. There is no crushing equipment.

Hutchinson Ranch Quarries. Several quarries were formerly operated on this property east of Santa Rosa.

Bibl: State Mineralogist's Reports X, p. 386; XI, p. 462; XII, p. 396; XIII, p. 634; XIV, p. 356; Bull. 38, pp. 343, 344.

Independent Sand and Gravel Co. J. P. Grady, president; Frank Allers, manager; home office, Forestville. The plant is located on the Russian River, one-half mile from Green Valley Station and about one and one-half miles from Forestville. Operations began in 1921. The system used here differs from most of the gravel plants in that the material is pumped by a 7-inch centrifugal pump mounted on a barge in the river to a pit on the shore below the plant. A grizzly at the pump discharge throws out any large boulders. A clam-shell bucket hoist picks up the sand and gravel from the pit and lifts it 100 feet to the screening and washing plant bin. Revolving screens segregate the material into sand, $\frac{3}{8}$ " to $\frac{3}{4}$ " and oversize. The bunkers discharge to either trucks or railroad cars; the plant being on a spur track of the Northwestern Pacific Railroad. Electric power is used, the connected load being 120 horsepower. Three men are employed.

Laurent Bros. Quarry. Laurent Bros. of Kenwood formerly operated the Annabel group on the Hutchinson Ranch property.

Lawndale Quarry. Three miles northwest from Kenwood. Idle.

Lounibos Quarry. A deposit of trachyte tuff in Sec. 36, T. 6 N., R. 5 W., one mile east of Agua Caliente. Stone from here has been used for curbing, a county bridge at Schellville and in the cemetery at Sonoma. Idle.

McDonald Ranch Quarries. The quarries on this property, which are among the oldest in the county, were first opened by McDonald in 1880. Cut stone, many millions of basalt blocks and crushed rock have all been produced here in the past. The stone was used in the Northwestern Pacific depot, St. Rose Church (1900), and the Carnegie Library (1903) in Santa Rosa. The property is two miles east of Santa Rosa at Baker Siding.

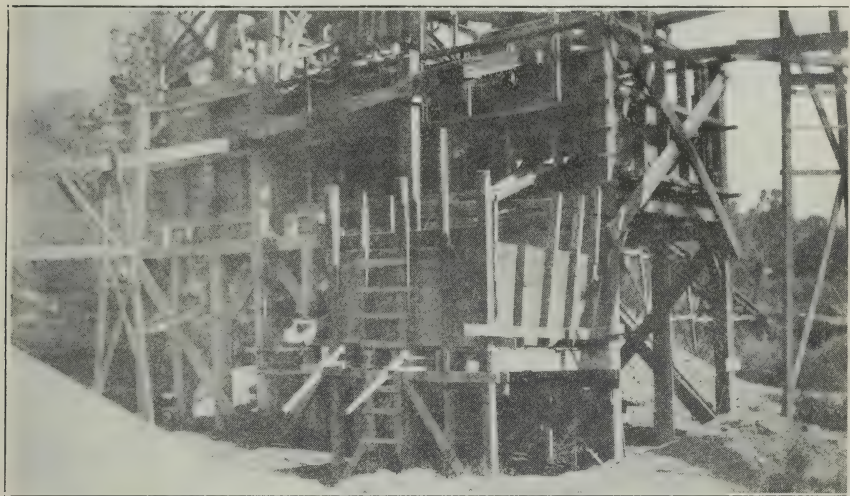
Bibl: State Mineralogist's Reports VIII, p. 635; X, p. 675; XII, p. 396; XIII, p. 634; XIV, p. 358; Bull. 38, pp. 163, 343, 344, 345.

Melitta Quarries. A group of basalt quarries one mile south of Melitta and five miles east of Santa Rosa. Idle.

Mirabel Gravel Company. Home office, Santa Rosa. This company, which has a lease on 40 acres covering bed and bars on the Russian River one mile from Forestville, began the production of 'bank run' and screened gravel in 1921. The plant is on a spur track of the Northwestern Pacific Railroad. Equipment consists of a LeClaire drag-line scraper, delivering to a hopper which discharges on to a belt conveyor with 150' centers set at an angle and discharging to a bin at the top of the screening plant. The material is passed through two

revolving screens which segregate sand, 'pea' gravel, $\frac{1}{2}$ " to $\frac{3}{4}$ ", and $\frac{1}{2}$ " to $2\frac{1}{2}$ " gravel. The material is all washed, water being supplied by a four-inch pump through 500 feet of pipe. The bunkers discharge to railroad cars (spur holds eight cars) or to trucks. 'Bank run' gravel can be loaded direct to railroad cars at the rate of one car in 35 minutes. Electric power is used and three men are employed. The plant has a capacity of 400 tons per day. Operation is curtailed during periods of high water in the river.

Northwestern Pacific Railroad. Has a quarry in the Stony Point section, about half way between Sebastopol and Petaluma. Operated intermittently for ballast and fills. Stone from this place was used as early as 1858 in building some of the oldest buildings in Petaluma and in the construction of the Carnegie Library in 1904.



Gravel screening plant of Mirabel Gravel Company, near Forestville, Sonoma County.

Petaluma Rock Quarry. A basalt rock quarry, first opened in 1864; last operated by E. B. and A. L. Stone Co. Is in Sec. 3, T. 4 N., R. 7 W., one and one-half miles south of Petaluma. Idle and dismantled.

Rincon Exchange Gravel Pit. This is a small gravel plant on Santa Rosa Creek, two miles east of Santa Rosa on the Sonoma highway. Idle.

Roblar Mining Company. Formerly produced crushed quartz for chicken grit and fines for plaster work and sanding from a quartz vein in serpentine near Roblar Station on the Petaluma and Santa Rosa Electric Railway. The property is idle.

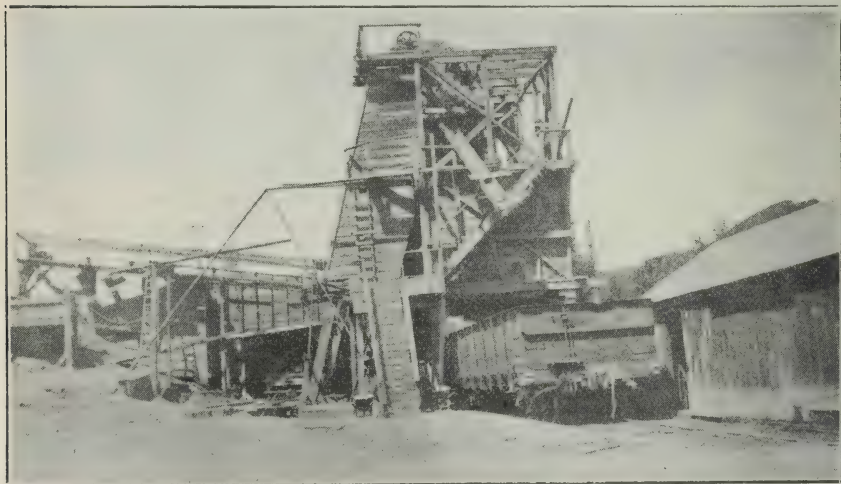
Bibl: State Mineralogist's Report XIV, p. 363.

Russian River Gravel Company. J. P. Grant, Healdsburg, owner. This plant is on a gravel bar on the Russian River, one-quarter mile east of Healdsburg. The plant was first built in 1906. It was enlarged in 1911 and again in 1924. The material is now excavated by a 5-yard drag-line scraper, which delivers the gravel to a revolving scalping screen above the crusher. The oversize is crushed. The

material from this primary plant is then hauled in side-tipping cars by a Winsted gasoline locomotive to the secondary screening and washing plant where the the bunkers are situated. This unit is on a spur track of the Northwestern Pacific Railroad. The material is washed and segregated into various sizes here. There is bunker storage



Excavator and conveyor to crushing unit, Russian River Gravel Company's Plant at Healdsburg, Sonoma County.



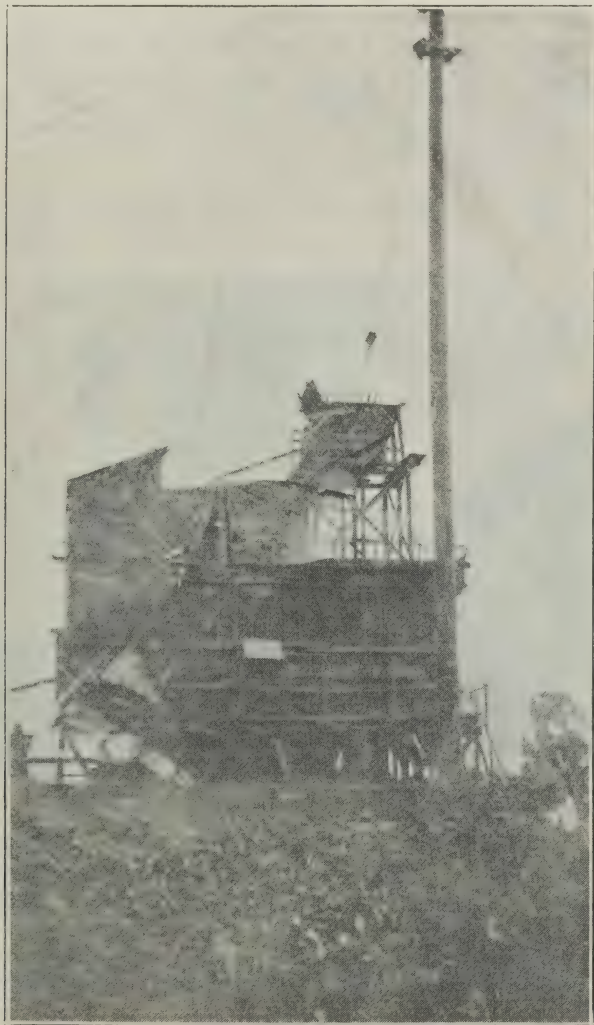
Screening and washing unit, with loading bunkers, Russian River Gravel Company's Plant, Sonoma County.

for 1400 yards of 'rock' and 2000 yards of 'sand' which can be taken up by belt conveyor. The capacity of the plant is 11 to 14 railroad ballast cars per day of screened material. Electric power is used throughout. Eight men are employed. The gravel is composed mainly of quartz, chert, and hard sandstone.

Bibl: State Mineralogist's Report XIV, pp. 363-364.

Schocken Quarry. Located on a steep hill one-half mile north of Sonoma, and first opened in 1876. About 1888 an average of 100,000 paving blocks per month were being shipped. It was later owned by Natomas Company of California and Coast Rock and Gravel Co. Idle.

Bibl: State Mineralogist's Reports VIII, p. 635; XI, p. 463; XII, p. 397; XIII, p. 635; XIV, p. 360; Bull. 38, p. 345.



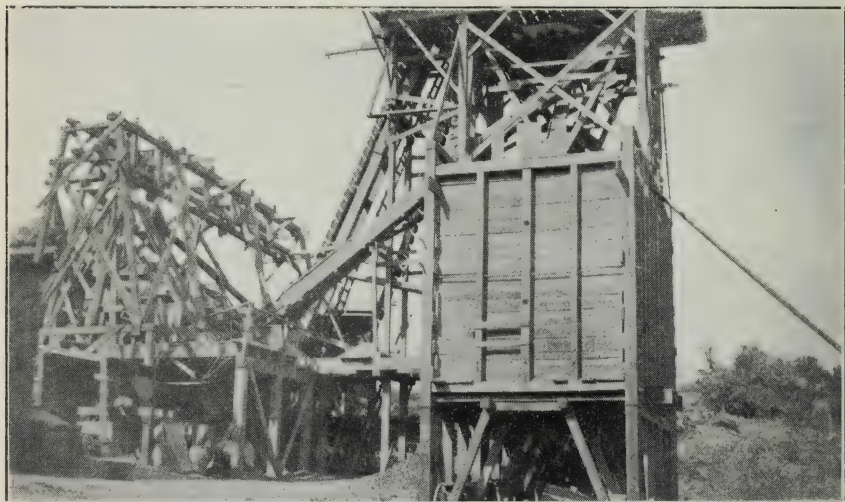
Plant of Sonoma Gravel Company, on Russian River,
near Chianti, Sonoma County.

Sonoma Gravel Company. C. R. Powrie, president; L. E. Smead, secretary; home office, Healdsburg. This company's plant is located on the Russian River opposite Chianti Station of the Northwestern Pacific Railroad, ten miles north of Healdsburg. The gravel in the river and bars at this point has been used for several years but the

present company began operations in April, 1926. The property comprises 47 acres covering the river bed and gravel bars. Only a few large boulders are encountered.

The slack-line excavating system is used, operating from a mast 96 feet in height. The bucket dumps into a bunker from which the material passes to a revolving screen. All over $2\frac{3}{4}$ " goes to a Gates No. 3 gyratory in closed circuit with the screen. The $2\frac{3}{4}$ " and under material is successively screened to $\frac{1}{4}$ " to dust; $\frac{1}{4}$ " to $\frac{1}{2}$ ", $\frac{1}{2}$ " to $\frac{3}{4}$ "; $\frac{3}{4}$ " to $2\frac{1}{2}$ " sizes, which go to separate bins from which railroad cars or trucks are loaded. There is no outside storage. A separate drag-line hoist loads 'river run' material for ballast direct to railroad cars. All segregated material is washed by water pumped from the river. Electric power is used, a total of 215 horsepower being required. Seven men are employed.

Stony Point Quarry. W. A. Wilson, Petaluma Star Route, owner. This quarry is situated in the Stony Point district, one-quarter mile



Crushed rock plant at Taylor Rock Quarry, near Santa Rosa, Sonoma County.

from the Petaluma and Santa Rosa Electric railway, and three miles a little west of south from Cotati. It was opened in 1922. The rock so far taken out is more or less altered and in places vesicular, but occasional lenses of dark, tough basalt are encountered. The plant is operated intermittently for road use. After shooting, the rock is trammed in ordinary mine cars to the crusher. The crusher run is elevated to a bin from which trucks are loaded. Electric power is used to operate the crusher and elevator.

Taylor Gravel Pit. John S. Taylor, owner, Santa Rosa. A drag-line excavator, gravel screening and washing plant is operated by Mr. Taylor on Santa Rosa Creek, two miles east of Santa Rosa on the Sonoma highway. There are bunkers for both fine and coarse gravel of various sizes from which trucks are loaded.

Taylor Rock Quarry. John S. Taylor, owner, Santa Rosa. This quarry is situated in the Melitta section, about three miles east of

Santa Rosa. During the past year two new faces have been opened and a better grade rock—a heavy dark-colored basalt—obtained. The rock is trammed to the crushing and screening plant, which is electrically operated. The primary crusher is a No. 5 Austin gyratory, which is supplemented by two smaller gyratories. All standard sizes of crushed rock are produced. Bunkers are provided for loading trucks. The plant was temporarily shut down at the time of visit, but is in practically continuous operation.

Titania Quarry. Two miles east of Santa Rosa. Idle.

Bibl: State Mineralogist's Reports XII, p. 396; XIII, p. 634; XIV, p. 365; Bull. 38, pp. 163, 345.

SULPHUR.

Native sulphur occurs at 'The Geysers,' but no commercial production has ever been made.

LOS ANGELES FIELD DIVISION.

W. BURLING TUCKER, Mining Engineer.

On account of unfinished field work, there is no report from the Los Angeles Division in this issue.



OIL FIELD DEVELOPMENT OPERATIONS.

By D. R. BUSH, State Oil and Gas Supervisor.

From May 2, 1926, to and including July 31, 1926, the following new wells were reported as ready to drill:

Company	Sec.	Twp.	Range	Well No.	Field
ALAMEDA COUNTY:					
J. E. Burney Syndicate No. 1-----	19	2	4	1	
FRESNO COUNTY:					
R. H. Sayers-----	14	20	14	Arizona 8	Coalinga
Standard Oil Co.-----	25	20	14	105	Coalinga
KERN COUNTY:					
Belridge Oil Co.-----	32	28	21	376-X	Belridge
Carneros Oil Co.-----	31	28	21	1	Belridge
Carneros Oil Co.-----	31	28	21	2	Belridge
Devils Den Products Co.-----	24	25	18	4	Devils Den
Devils Den Products Co.-----	23	25	18	5	Devils Den
Gross Drilling Co.-----	26	30	24	4	Elk Hills
Pan American Petroleum Co.-----	1	31	24	Crampton 4-I	Elk Hills
Standard Oil Co.-----	27	30	24	122	Elk Hills
Union Oil Co.-----	26	30	24	Elk Hills 15	Elk Hills
Union Oil Co.-----	26	30	24	Elk Hills 16	Elk Hills
Barnsdall Oil Co.-----	28	27	27	Leutholtz 2	Kern River
Carissa Oil Co.-----	28	27	27	1	Kern River
Carrec Oil Co.-----	11	28	27	1	Kern River
George F. Getty-----	14	28	27	Lehnhardt 5	Kern River
George F. Getty, Inc.-----	22	28	27	Tegeler 4	Kern River
George F. Getty, Inc.-----	22	28	27	Tegeler 7	Kern River
Petroleum Securities Co.-----	28	28	27	1	Kern River
Superior Oil Co.-----	34	27	27	Leutholtz 1	Kern River
Sure Oil Co.-----	26	28	28	1	Kern River
Union Oil Co.-----	35	27	27	Miller 1	Kern River
F. G. Wagner-----	34	28	28	16	Kern River
Wing and Skakel-----	34	28	28	1	Kern River
Universal Consolidated Oil Co.-----	30	26	21	15	Lost Hills
Universal Consolidated Oil Co.-----	30	26	21	16	Lost Hills
Associated Oil Co.-----	20	31	23	1	Midway
Associated Oil Co.-----	20	31	23	23	Midway
Balboa Oil Co.-----	24	31	23	52	Midway
Balboa Oil Co.-----	24	31	23	53	Midway
California Petroleum Corp.-----	34	32	24	Dorothy 7	Midway
Carolina Western Oil Co.-----	36	32	23	3	Midway
Hugh B. Evans, Inc.-----	4	32	23	4	Midway
Hugh B. Evans, Inc.-----	4	32	23	5	Midway
King G. Gillette-----	21	31	22	A-5	Midway
King G. Gillette-----	21	31	22	B-4	Midway
King G. Gillette-----	21	31	22	B-11	Midway
King G. Gillette-----	21	31	22	B-12	Midway
Honolulu Consolidated Oil Co.-----	4	32	24	2	Midway
Honolulu Consolidated Oil Co.-----	12	32	24	6	Midway
Honolulu Consolidated Oil Co.-----	12	32	24	9	Midway
Honolulu Consolidated Oil Co.-----	8	32	24	28	Midway
Honolulu Consolidated Oil Co.-----	8	32	24	39	Midway
Honolulu Consolidated Oil Co.-----	4	32	24	65	Midway
Honolulu Consolidated Oil Co.-----	4	32	24	74	Midway
Honolulu Consolidated Oil Co.-----	4	32	24	75	Midway
Honolulu Consolidated Oil Co.-----	6	32	24	76	Midway
Honolulu Consolidated Oil Co.-----	4	32	24	84	Midway
Midland Oilfields Co., Ltd.-----	34	31	24	Thornber 7	Midway
Pioneer Midway Oil Co.-----	30	31	23	8	Midway
Security Development Co.-----	15	31	22	12	Midway
Standard Oil Co.-----	29	31	23	1	Midway
Standard Oil Co.-----	29	31	24	2	Midway
Standard Oil Co.-----	29	31	24	4	Midway
Standard Oil Co.-----	29	31	24	5	Midway
Standard Oil Co.-----	29	31	24	6	Midway
Standard Oil Co.-----	29	31	24	7	Midway
Standard Oil Co.-----	33	31	24	12	Midway
Standard Oil Co.-----	21	32	24	12	Midway
Standard Oil Co.-----	3	32	24	36	Midway
Standard Oil Co.-----	17	32	24	37	Midway
Standard Oil Co.-----	19	31	24	45	Midway
Standard Oil Co.-----	19	31	24	46	Midway
Standard Oil Co.-----	5	32	24	46	Midway
The United Oil Co.-----	19	31	23	Calidon 7	Midway
The United Oil Co.-----	20	31	23	United 5	Midway

OIL FIELD DEVELOPMENT OPERATIONS—Continued.

Company	Sec.	Twp.	Range	Well No.	Field
KERN COUNTY—Continued.					
Western Production Co.	21	31	22	6	Midway
Bankline Oil Co.	6	11	23	10	Sunset
Beverly Oil Co.	6	11	23	9	Sunset
Blanc & Heasley	6	11	23	4	Sunset
Lewis Petroleum Co.	34	12	24	G-M 16	Sunset
John F. Lingo	10	11	23	1-A	Sunset
Midway Northern Oil Co.	32	12	23	14	Sunset
Midway Northern Oil Co.	32	12	23	15	Sunset
Pacific Oil Co.	30	12	23	93	Sunset
Standard Oil Co.	31	12	23	34	Sunset
Standard Oil Co.	31	12	23	52	Sunset
Standard Oil Co.	10	11	23	Rass 3	Sunset
Union Oil Co.	10	11	23	Boss 2	Sunset
Standard Oil Co.	27	11	20	Kern Co. Lease No. 2 24	Wheeler Ridge
Standard Oil Co.	27	11	20	Kern Co. Lease No. 2 25	Wheeler Ridge
Eliot M. Ashe	2	27	27	Ashe 1	
Blythe & Weatherwax	28	11	23		
George O. H. Buchner	20	26	28		
George O. H. Buchner	14	27	28		
W. H. Davis	13	26	17		
General Petroleum Corp.	29	27	28		
George F. Getty, Inc.	17	27	27	DePauli-Kane 23	
John Lucas and Associates	10	27	27		
Milham Exploration Co.	33	11	22	Pioneer 2	
Petroleum Securities Co.	8	27	28		
Shell Co.	21	11	22	San Emigdio 1	
Nelson G. Smith	10	26	27		
Union Oil Co.	4	27	28	Sarret 1	
LOS ANGELES COUNTY:					
Shell Co.	34	3	13	Reyes 34	Dominguez
Union Oil Co.	33	3	13	Hellman 13	Dominguez
Associated Oil Co.	7	2	14	Vickers 50	Inglewood
Standard Oil Co.	17	2	14	Baldwin 31	Inglewood
Standard Oil Co.	17	2	14	Baldwin 34	Inglewood
Standard Oil Co.	17	2	14	L.A. Invest. 1 49	Inglewood
Standard Oil Co.	16	2	14	Stocker 6	Inglewood
Standard Oil Co.	7	2	14	Vickers 2 11	Inglewood
Acme Petroleum Corp.	19	4	12	Damron 1-A	Long Beach
California Petroleum Corp.	13	4	13	Bryant 2	Long Beach
California Petroleum Corp.	19	4	12	Fields 11	Long Beach
Fisher Oil Co.	20	4	12	Dodge 2	Long Beach
Fred F. Fitch	33	4	12		Long Beach
Gem Oil Co.	13	4	13		Long Beach
A. T. Jergins Trust	19	4	12		Long Beach
A. T. Jergins Trust	19	4	12		Long Beach
J. D. Lauricella	20	4	12		Long Beach
L. J. McAlpine	13	4	13	McAlpine 4	Long Beach
Miller and Haley	25	4	13		Long Beach
J. G. Richardson & Charles A. Son	24	4	13	Richardson 5	Long Beach
J. G. Richardson & Charles A. Son	24	4	13	Richardson 7	Long Beach
Fred W. Roberts	29	4	12		Long Beach
San Martinez Oil Co.	29	4	12	Dillman 1	Long Beach
K. L. Smith	13	4	13	Smith 1	Long Beach
Union Oil Co.	30	4	12	Long Beach Community 13	Long Beach
The United Oil Co.	19	4	12	Hass 8	Long Beach
Baldwin-Stocker Oil Estates	1	2	12	5-B	Montebello
McGinley Oil Co.	6	2	11		Montebello
The St. Helens Petroleum Co., Ltd.	2	2	12	McDonald 1	Montebello
St. Helens Riverside Properties	2	2	12	Monterey 13	Montebello
Standard Oil Co.	2	2	12	Baldwin 61	Montebello
Standard Oil Co.	6	2	11	Baldwin 68	Montebello
Standard Oil Co.	2	2	12	Benedictine 1	Montebello
Superior Oil Co.	2	2	12	Masser 1	Montebello
Associated Oil Co.	34	2	14	Cypress 1	Rosecrans
Barnsdall Oil Co.	18	3	13	O'Dea 13	Rosecrans
Barnsdall Oil Co.	18	3	13	O'Dea 14	Rosecrans
Union Oil Co.	18	3	13	Howard Park 28	Rosecrans
Union Oil Co.	18	3	13	Howard Park 29	Rosecrans
Union Oil Co.	18	3	13	Rosecrans 8	Rosecrans
General Petroleum Corp.	5	3	11		Santa Fe Springs
General Petroleum Corp.	5	3	11	Santa Fe 24	Santa Fe Springs
Chanslor-Canfield Midway Oil Co.	9	4	14	Del Amo 39	Torrance
Chanslor-Canfield Midway Oil Co.	9	4	14	Del Amo 45	Torrance
Chanslor-Canfield Midway Oil Co.	16	4	14	Del Amo 49	Torrance
Chanslor-Canfield Midway Oil Co.	9	4	14	Del Amo 51	Torrance
Chanslor-Canfield Midway Oil Co.	9	4	14	Del Amo 57	Torrance
Chanslor-Canfield Midway Oil Co.	9	4	14	Del Amo 62	Torrance

OIL FIELD DEVELOPMENT OPERATIONS—Continued.

Company	Sec.	Twp.	Range	Well No.	Field
LOS ANGELES COUNTY—Cont.					
Chanslor-Canfield Midway Oil Co.	8	4	14	Del Amo 67	Torrance
Chanslor-Canfield Midway Oil Co.	8	4	14	Del Amo 73	Torrance
Chanslor-Canfield Midway Oil Co.	8	4	14	Del Amo 79	Torrance
Shell Co.	8	4	14	Redondo	
Shell Co.	8	4	14	Comm. 14	Torrance
Shell Co.	8	4	14	Redondo	
Standard Oil Co.	22	4	14	Comm. 15	Torrance
Superior Oil Co.	19	4	13	Marble Lease 13	Torrance
Superior Oil Co.	24	4	14	Torrance 45	Torrance
Pan American Petroleum Co.	16	2	11	Torrance 64	Torrance
York-Smullin Drilling Co.	16	2	11	Chanchorena 1	Whittier
Barnsdall Oil Co.	35	1	11	1	Whittier
Julian Petroleum Corp.	24	3	15	Merlo 1	
Marine Corp.-Western Corp.	24	3	12	Meyer & Platt 1	
Marland Oil Co.	11	5	12	Strong 1	
Petroleum Securities Co.	14	2	16	Bixby 2	
Standard Oil Co.	11	1	17	Sesnon 1	
Union Oil Co.	24	2	15	Austin 1	
				Howland 1	
MONTEREY COUNTY:					
Sam Clark	5	19	10	1	
Petroleum Securities Co.	27	23	13	White 1	
ORANGE COUNTY:					
Brea Canon Oil Co.	1	3	10	39	Brea Olinda
Fullerton Oil Co.	2	3	10	21	Brea Olinda
General Petroleum Corp.	1	3	10	Tonner 2-A	Brea Olinda
Shell Co.	8	3	9	Columbia 40	Brea Olinda
The St. Helens Petroleum Co., Ltd.	18	3	9	Anderson 5	Coyote Hills
Julian Petroleum Corp.	10	6	11	Lambert 1	Huntington Beach
McKeon Oil Co.	10	6	11	Huntington 1	Huntington Beach
E. J. Miley	10	6	11	Pacific Electric 1	Huntington Beach
E. J. Miley	10	6	11	Pacific Electric 2	Huntington Beach
Standard Oil Co.	34	5	11	Bolsa 25	Huntington Beach
Standard Oil Co.	34	5	11	Huntington A-31	Huntington Beach
Standard Oil Co.	3	6	11	Huntington A-32	Huntington Beach
Standard Oil Co.	3	6	11	Huntington B-47	Huntington Beach
Standard Oil Co.	3	6	11	Huntington B-48	Huntington Beach
Standard Oil Co.	2	6	11	Huntington B-49	Huntington Beach
Sun Oil Co.	2	6	11	10	Huntington Beach
Superior Oil Co.	10	6	11	Jones 1	Huntington Beach
The United Oil Co.	2	6	11	Dabney 7-A	Huntington Beach
The United Oil Co.	2	6	11	Pacific 2	Huntington Beach
Wilshire Oil Co., Inc.	10	6	11	H. B. 1	Huntington Beach
Wilshire Oil Co., Inc.	10	6	11	H. B. 2	Huntington Beach
Julian Petroleum Corp.	21	6	10	Strowbridge B 2	Newport
General Petroleum Corp.	28	3	9	Thompson 1-A	Richfield
S. H. Keoughan, Trustee	30	3	9	Kraemer-	
				Keoughan 2	Richfield
Nugent Drilling Co.	27	3	9	1	Richfield
Standard Oil Co.	29	3	9	Kraemer 2 22	Richfield
Union Oil Co.	29	3	9	Chapman 25	Richfield
Union Oil Co.	29	3	9	Coyle 6	Richfield
Union Oil Co.	29	3	9	Coyle 7	Richfield
Union Oil Co.	29	3	9	J. W. Newell 5-A	Richfield
Union Oil Co.	29	3	9	J. W. Newell 6	Richfield
California Pet. Developing Co.	2	8	8	1	
RIVERSIDE COUNTY:					
Floyd Amundson	11	2	4	1	
SAN DIEGO COUNTY:					
Cardiff Oil Corp.	24	13	4	Turner 1	
SAN LUIS OBISPO COUNTY:					
George Mapes Holdings	19	10	24	1	
SANTA BARBARA COUNTY:					
R. & G. Oil Co.	30	9	32	9	Cat Canyon
Standard Oil Co.	13	9	33	Palmer Union 1	Cat Canyon
Smith & Barmore	--	4	26	2	Summerland
West Penn Producing Co.	--	8	31	Shields 1	
SANTA CRUZ COUNTY:					
Frank Marik	--	11	2	1	
SONOMA COUNTY:					
O. F. W. Drilling Co., Inc.	--	5	6	1	
Shell Co.	*	*	*	Murphy 1	

*Lot 270, Rancho Petaluma.

OIL FIELD DEVELOPMENT OPERATIONS—Continued.

Company	Sec.	Twp.	Range	Well No.	Field
TULARE COUNTY:					
Federal Exploration Co.	15	22	24	Kinsella 1	-----
VENTURA COUNTY:					
O. R. Howard	5	3	19	Elkins 3	Bardsdale
Hassock Oil Co.	12	4	22	1	Ojai
Hess-Rue-Henderson Oil Co., Inc.	33	4	23	7	Ojai
Frank Shannon	8	4	21	1-A	Ojai
Henderson Petroleum Corp.	33	5	18	Kaar 2	Piru
Leonard Brothers	4	4	18	1	Piru
Ruth J. Bishop and Buckeye Union Oil Co.	34	5	19	2	Sespe
Border Oil Co.	8	5	19	1	Sespe
Oak Ridge Oil Co.	13	3	21	Harvey 18	South Mountain
Oak Ridge Oil Co.	13	3	21	South	
Associated Oil Co.	22	3	23	Mountain 9	South Mmountain
Associated Oil Co.	27	3	23	Hartman 5	Ventura
Associated Oil Co.	27	3	23	Lloyd 2-A	Ventura
Associated Oil Co.	27	3	23	Lloyd 32	Ventura
Associated Oil Co.	27	3	23	Lloyd 38	Ventura
Associated Oil Co.	27	3	23	Lloyd 45	Ventura
Associated Oil Co.	23	3	23	McGonigle 2	Ventura
Associated Oil Co.	26	3	23	V. L. & W. 1	Ventura
General Petroleum Corp.	22	3	23	Barnard 1-A	Ventura
General Petroleum Corp.	28	3	23	Barnard 2	Ventura
General Petroleum Corp.	28	3	23	Barnard 6	Ventura
General Petroleum Corp.	21	3	23	Barnard 7	Ventura
Miley Oil Co.	7	3	23	Casitas 2	Ventura
Shell Co.	28	3	23	Edison 7	Ventura
Shell Co.	28	3	23	Edison 9	Ventura
Shell Co.	28	3	23	Edison 10	Ventura
Shell Co.	28	3	23	Gosnell 12	Ventura
Shell Co.	28	3	23	Gosnell 13	Ventura
Shell Co.	28	3	23	Taylor 14	-----
Standard Oil Co.	20	2	22	Valentine 3	-----
Rio Grande Oil Co.	9	3	23	Canet 1	-----
Sentinel Oil Co.	36	2	21	1	-----
Standard Oil Co.	29	2	20	Camarillo 1	-----
Standard Oil Co.	17	2	22	Valentine 2	-----

SPECIAL ARTICLES.

Detailed technical reports on special subjects, the result of research work or extended field investigations, will continue to be issued as separate bulletins by the Bureau, as has been the custom in the past.

Shorter and less elaborate technical papers and articles by members of the staff and others are published in each number of 'Mining in California.'

These special articles cover a wide range of subjects both of historical and current interest; descriptions of new processes, or metallurgical and industrial plants, new mineral occurrences, and interesting geological formations, as well as articles intended to supply practical and timely information on the problems of the prospector and miner, such as the text of new laws and official regulations and notices affecting the mineral industry.

GAS, GASOLINE AND PETROLEUM.

By A. H. RICKETTS, of the San Francisco bar.

The line of demarcation between oil and gas is indistinct. It is well recognized that each is of the series of hydro-carbons. It would be a clear perversion of language to hold that gas and oil are synonymous terms.¹

The ultimate origin of casinghead gas is contemporaneous with the petroleum with which it is associated. The gas is essentially a mixture of natural gas and the vapors of the lighter components of petroleum.² Casinghead gas is the name given to the gas which flows from oil wells, and as a rule, comes from the same 'sand' or formation, as the oil. Its name is derived from the fact that it is taken from the well through the casinghead. It consists of a mixture of the lighter members of the methane series, namely, methane, ethane, propane, butane, pentane, etc., but heavier hydro-carbons than predominant in natural gas. Both natural and casinghead gas are mainly composed of hydro-carbons.³ The statement sometimes is made that the gasoline in the casinghead gas is derived from the crude oil. This is incorrect when used in the sense that the casinghead gas takes gasoline from the crude oil.⁴

J. O. Lewis in treating of 'The Solubility of Gases in Petroleum' says:⁵ "The gas held in solution by the oil is an essentially important factor in the recovery of oil from the formations in which it is found. 'Under the same conditions of temperature and pressure a particular oil will absorb a fixed proportion of a particular gas, but this proportion or coefficient of absorption, as it is called, varies with each oil and each gas. The gas is held absorbed in the oil in the same way that soda water is charged with carbon dioxide. The proportion of gas absorbed is increased under high pressures, in accordance with Henry's law of gases. Enormous quantities of gas are held in solution under the high initial pressure found in some oil wells. Some of the constituent gases are condensed at these high pressures just as in a compressor plant, and as long as high enough pressure is maintained, exists as liquids dissolved in the oil. Under such conditions the gas is not absorbed as a gas but as one liquid dissolved in another, and a much greater proportion of gas can be held in solution when in liquefied form than when uncondensed. Other gases (methane, ethane, and propane) are never liquefied at the pressures and temperatures in oil sands penetrated by wells, but are

¹ Truby v. Palmer (Pa.), 6 Atl. 74.

² Westcott's Handbook of Casinghead Gas, (3rd ed.), p. 8.

³ Id. p. 35.

⁴ Id. p. 33.

⁵ Bulletin 48, p. 11.

always found as gases dissolved or absorbed in the oil. These constitute the so-called dry gases.' "

Mr. Lewis also shows a table which indicates the physical properties of various hydro-carbons and the constituent elements of casinghead natural gas. From this table the following facts are apparent: Petroleum contains some of the same hydro-carbons as are contained in dry gas. It also contains some of the same as wet gas or casinghead gas. All three contain those hydro-carbons from which gasoline is made, in varying proportions.

The usual classification with reference to the gas is whether or not the gas is dry or the gas is wet. Bacon and Hamor, in their manual⁶ give a glossary of all the terms used in the oil industry. 'Natural Gas' is defined as a 'gaseous product arising from petroleum wells.' Natural gas is divided into two classifications. 'Dry Natural Gas' and 'Wet Natural Gas.' Dry natural gas is defined as follows: 'Natural gas which does not contain an appreciable amount of readily condensible gasoline. It is not usually associated with petroleum.' Wet natural gas is defined as follows:

'(1) Natural gas from which gasoline can be extracted in sufficient quantities to warrant the installation of a plant.

'(2) Natural gas which contains readily condensible gasoline.'

It will be observed, therefore, that natural gas is subdivided into these two classes and that there is no atomic or elementary difference, except that one contains sufficient gasoline to be readily condensible, while the other does not. In other words, they both contain gasoline in the uncondensed form, but one contains such a small amount of condensible gasoline it cannot be readily condensed, and is therefore not commercial. It is regarded as dry gas.

Petroleum has long been popularly regarded as a mineral oil, as its derivation indicates. The word means 'rock oil,' an oily substance so named because found naturally oozing from crevices in rocks.⁷ Petroleum oil is a fluid found in the porous sand-rocks of the earth.⁸ The meaning of the word 'gas' is neither ambiguous nor uncertain, but is well understood.⁹ Gas coming from an oil well, passing through the casing, making its exit through the head of the casing, receives the designation of 'casinghead gas,' which is no other than 'gas from an oil well.'¹⁰ The language 'if the party of the second part shall market any gas from any well producing gas * * * applies to gas marketed, whether from a well producing gas only or from a well producing both oil and gas.'¹¹ Gas is not an exhalation of oil, nor is it held in solution by the oil to any considerable extent. Gas and oil are in their chemical composition, no doubt, both hydro-carbons, but are distinct and different products.¹² A sale of oil, gas and mineral rights which obligates the purchaser to deliver to the seller one-eighth part of all oil produced and saved from the land, does not cover gas, gasoline, or carbon produced from the gas; gasoline may be of the same generic species or family of minerals as that of oil, but it cannot be classed as oil or substituted for oil, within the intent and meaning of the word 'oil' as

⁶ American Petroleum Industry.

⁷ *Burke v. S. R. R. Co.*, 234 U. S. 669.

⁸ *Wagner v. Mallory*, 169 N. Y. 501, 62 NE 584.

⁹ *Burton v. Forrest Oil Co.*, 204 Pa. St. 349, 54 Atl. 266.

¹⁰ *Mussellem v. M. P. Co.*, 107 Okla. 183, 231 Pac. 526.

¹¹ *Withington v. Gypsy Oil Co.*, 68 Okla. 138, 172 Pac. 634.

¹² *Bernard etc. Co. v. Farquharson*, 1913 B Ann. Cas. 1212 English Privy Council, July 31, 1912, Canada Case.

used in the contract of sale.¹³ Gasoline manufactured from casinghead gas is not 'oil' as that term is used in an oil and gas lease.¹⁴

There is a confusion of terminology in the use of 'casinghead gas,' 'casinghead gasoline' and 'gas from an oil well.' Gasoline or casinghead gasoline is produced from casinghead gas, or gas from an oil well, by a process of manufacture or distillation.

'Casinghead gas' and 'gas produced from an oil well' are the same substances, sometimes taking the name of the head of the casing through which it escapes, being the casinghead, and called 'casinghead gas,' and sometimes taking the name 'gas from an oil well.'¹⁵

Neither casinghead gas nor gasoline manufactured therefrom is a component part of crude petroleum in the well, and the right to take the same under the term 'oil,' as used in the granting clause of a lease, is denied, because the word 'oil,' as used in an oil and gas lease, means the oil produced from a well or crude petroleum in its natural state.¹⁶

Gasoline as such, never comes from the mouth of the well. Sometimes when the flow of gas is impeded through the pipe lines leading from the casinghead to the plant or other points, there is a 'drip' formed. This is occasioned by the heavier hydro-carbons in the gas coming in contact with the cold section of the line. The liquid so formed is negligible.

In Westcott's Handbook of Casinghead Gas¹⁷ may be found data from which one will be enabled to form an idea as to the machinery and processes employed in the manufacture of casinghead gasoline, and will see that casinghead gasoline is the result of a process of manufacture and that it is not a substance that drips out of the gas like water from a sponge, as some of the authorities indicate.

COPPER IN CALIFORNIA.

History.

By C. A. LOGAN, Mining Engineer.

Copper mining in California has occurred in three cycles, each of which has affected in general all the mines of the state, but each especially marked by the development of some particular district. The metal was known in the fifties in many counties of the state, but copper mining did not begin until 1860, when the discovery of the Napoleon Mine in southwestern Calaveras County initiated the first commercial production. During the period 1861-1869 the Napoleon, Union, Keystone, Empire, Campo Seco and smaller mines of Calaveras County were developed and produced ores containing from 12% to 25% copper. Only good grade ore could be handled because of the expense of marketing. Ore had to be taken by team, steamer and later by rail to San Francisco for transshipment to eastern refineries or to Swansea, Wales; but a few small reverberatory and blast furnaces were built in the state and were producing matte before the latter year. Other counties became productive, as visiting miners returned to their homes from the Calaveras mines and took up the search. Production was established in practically every county on the western slope of the Sierra Nevada, from Tulare at the south to Plumas. Several of the Coast counties shared in the activity, Del Norte, in the extreme northwestern end of the state, ranking second to Calaveras. The Union, Empire and Keystone mines of Calaveras County, now consolidated and producing under the Calaveras Copper Company, produced 125,739 tons of ore assaying 10% copper or better, between 1861 and 1869. The price of copper fell

¹³ Wilkins v. Nelson, 155 La. 807, 99 So. 607.

¹⁴ Mussellem v. M. P. Co., *supra*.¹⁰

¹⁵ *Id.*

¹⁶ Mullendore v. Minnehoma Oil Co., Martin's Oil & Gas Legal Service, Vol. 6, No. 2, p. 136, decided by the Commission of Appeals, State of Okla., Nov. 12, 1924.

¹⁷ (3rd ed.) p. 277, et seq.

to a point where the mines of this state could make little or no profit and most properties lay idle between 1869 and 1880. The mines of the Foothill Copper Belt had yielded their richest ores previous to this depression, but the great deposits of Shasta County had remained nearly untouched and their size was not realized by the few men who had prospected there.

The prominent gossan outcrops of the Shasta Copper Belt were not recognized for many years as the cappings of important copper deposits. The Iron Mountain Mine was located in the early sixties as an iron mine, and so held until 1879, when gold and silver were found in the gossan by James Sallee, who operated it for these metals. Its career as a copper mine began in 1895, marking the advent of the second cycle of copper mining. The early work at the Bully Hill and Ingot mines was also for gold and silver.

The region by this time had a railroad passing through the copper belt, limestone and quartz were available nearby for flux and blast furnaces were built, so that it was possible to treat at a profit the large but comparatively low grade orebodies. Shasta County became the principal copper producer of the state. Between 1896 and 1925, inclusive, the mines produced 661,530,103 pounds of copper from a total of over 6,000,000 tons of ore. The principal producing properties were the Mammoth, Iron Mountain, Balaklala, Golinsky and Shasta King on the west side, and the Bully Hill, Rising Star and Afterthought on the east. The collapse of the copper market at the end of the war, and the continued low price of copper, has resulted in the practical cessation of copper mining in that district. Production during the war was stimulated to the point where most accessible reserves of copper were exhausted. Remaining proved orebodies are probably too low grade for exploitation under prevailing costs and at the present market price for the metal. The blast furnaces of the Mountain Copper Company at Keswick and of the Mammoth Copper Company at Kennett have been dismantled. Copper at present is produced in Shasta County principally from the Rising Star Mine at Bully Hill and the Afterthought Mine at Ingot, where the ores are worked chiefly for their zinc content. The Balaklala Mine is being reopened by the Mason Valley Mines Company, as the type of ore found there is needed at their Thompson smelter.

The third and latest development of copper mines in California has been along the Plumas Copper Belt in Plumas County, where the Engels Group and the Walker Mine are the chief producers. Many smaller mines in the same section are idle at present. Engels and Superior mines were developed by Engels Brothers over a period of many years, and became important producers in 1915. The ore from the consolidated groups was treated in the first oil flotation plant operated on a commercial scale in California, as the sole means of concentration. This plant has been enlarged several times and has an ultimate capacity of 1500 tons a day. In recent years its output has been averaging over 1,000,000 pounds of copper a month, reaching 1,250,000 pounds monthly at times.

Walker Mine, operated by a subsidiary of Anaconda Copper Company, is 17 miles south of Engels. While the flotation plant here has less than half the capacity of that at Engels, the annual production does not lag far behind, amounting to 11,301,159 pounds for the year ending June 30, 1924. The copper output of the county, coming almost entirely from these two groups, amounted, in 1925, to 26,950,029 pounds. Besides the counties mentioned, where the bulk of our copper

production has occurred, smaller and irregular production has been made from Trinity, Siskiyou, Placer, Inyo, San Bernardino and other counties. The Island Mountain Mine in southwestern Trinity County is the only present producer of any importance in this list.

Geology of Copper Deposits.

The mines differ considerably as regards geology and types of ore. In the workings of the Calaveras Copper Company (the old Keystone, Empire and Union mines) the ore is chalcopyrite with more or less pyrite and is deposited typically along seams in black Mariposa (Jurassic) slate, in the form of lenses with their long axes parallel to the dip and strike of the bedding planes of the slate. The main ore body is 600 feet long, averaging 15 feet wide, dips 61 degrees north-east and strikes northwest. Serpentine lies on the footwall of the slate and amphibolite schist, or meta-dabase, on the hanging wall. A granodiorite dike, said to carry up to $1\frac{1}{2}\%$ copper, has been noted as an intrusive in the slate. The main orebody averages 4% copper but at times rich bunches of chalcopyrite, carrying as much as 20% copper, are found. Smelter returns show no gold, and only one ounce of silver for each 980 pounds of copper. Present work is through a shaft 1250 feet deep on the dip.

Other past producers in the same county, such as the Penn Mine and the Napoleon Mine, show lens-shaped orebodies in amphibolite or meta-dabase, with the ores carrying gold, silver and zinc as well as copper. The Calaveras Copper Company is the only operator not having gold or silver in their ore sufficient to aid them.

The Engels deposit in Plumas County was first described by H. W. Turner and A. F. Rogers as a magmatic segregation in norite-diorite, which was probably a differentiation product of the granodiorite batholith of the Sierra Nevadas. L. C. Graton and D. H. McLaughlin later expressed the opinion that the ore minerals were introduced after the rock had solidified and had suffered notable dynamic and structural changes. The Engels ore is generally low grade and disseminated; in the adjoining Superior Mine, owned by the same company, the ore is deposited largely along joint planes and is clearly secondary. The oxidized zone showed a leached rock, stained by malachite, limonite and chrysocolla. It was irregular in its lower limits, merging into chalcocite and carbonates. Below this the zone of sulphide enrichment was 25 feet thick, yielding chalcocite carrying 16% to 20% copper. Lower grade bornite ore appeared at a depth of 100 to 130 feet. Pyrite is absent or nearly so. The average length of the Engels orebody is 800 feet, average width 60 feet with no naturally well-defined walls. The average ore milled (the mixed product of the two mines) contains $2\frac{1}{4}\%$ copper, a little gold and silver. No. 10 tunnel, completed in 1925 at a cost of \$400,000, has a depth of 1262 feet. Engels' total production to date has been about 110,000,000 pounds of copper.

At the Walker Mine, second largest copper producer in the state, the vein is a strong well-defined quartz-filled fissure in hard diorite walls. On No. 3 level the vein was 20 feet wide, and on No. 4 level 45 feet wide, and the ore-shoot was 900 feet long. A high-grade streak five to six feet wide and 140 feet long on No. 4 level, carried 15% to 17% copper. Chalcopyrite is most prominent, but bornite occurs, and pyrite is common. The gangue contains barite as well as quartz. The

ore runs $3\frac{1}{2}\%$ to 4% copper, 0.6 ounce silver and 0.1 ounce gold per ton. No. 8 tunnel, at an elevation of 6200 feet above sea-level, is the main working level, giving a depth of 800 feet.

In Shasta County's copper belt, the orebodies occur in the Bully Hill and Balaklala rhyolites. The orebodies are roughly lens-shaped, occupying shear zones, and ranging from a few inches to 100 feet wide. Their age is thought to be Jurassic. The Mammoth orebody was 800 feet long and 200 feet deep, consisting of flat-lying lenses. It averaged 3% copper and \$2 per ton in gold and silver, the principal minerals contained being pyrite, chalcopyrite and sphalerite. Another example is the immense pyrite deposit of the Mountain Copper Company's Hornet Mine, mined as a source of sulphuric acid, and carrying only 0.7% copper.

At Bully Hill and Ingot, the ores of the mines formerly worked entirely for copper have shown in later years an increasing amount of zinc. It is a complex, finely disseminated ore, carrying an average of 16% zinc and 3% copper, with $5\frac{1}{2}$ ounces of silver and 0.03 ounce gold per ton, at the Afterthought Mine. In the Rising Star Mine at Winthrop the zinc content of the ore reaches 22%. Both properties are being operated by California Zinc Company. Depths of 800 and 1100 feet, respectively, have been reached.

Besides these developed and producing districts there are promising deposits in Siskiyou County, notably the Grey Eagle Mine near Happy Camp and the Blue Ledge Mine in Elliott Creek district, near the Oregon state line. Numerous gossan outcrops, showing copper, but only slightly prospected occur throughout the western and northern parts of the county. The region of these mines has no railroad and the character of the country is such that mineral products and timber are the only probable sources of revenue likely to be developed.

Milling and Smelting; Present Status of Operations.

California copper mines have been handicapped from early days by distance from smelters and markets. In the sixties ore was hauled by teams even from such remote districts as Alpine County, on the Nevada State line, across the Sierra Nevadas to Sacramento for shipment to the east or abroad by water. In Calaveras County, mines are some distance from railroad. Smaller properties shipped ore, 10% ore being about as low grade as could be handled, though this varied with distance from railroad. Both the Penn Mine at Campo Seco (now idle), and the Calaveras Copper Company, have operated blast and reverberatory furnaces. As they are outside the National Forests and not in a farming country, they were not molested. The latter company has lately put a new reverberatory furnace in commission. Ore is concentrated by oil flotation, giving a product containing 18% copper which is sintered in a Dwight & Lloyd sintering machine, smelted, and matte treated in converters and blister copper shipped to Tacoma. The blast furnace is kept to smelt ore containing 10% or more of copper. The flotation plant can handle 400 tons of 4% ore daily.

Agitation that arose in Shasta County forced the installation of bag houses at the smelters. The semi-pyritic process of smelting was used at Kennett, where the smelter capacity was 2200 tons, the ore averaging 3% copper in recent years. No smelters are in commission in that county, the last named having been the last in operation, but now being in process of wrecking.

Numerous methods for the separation of copper and zinc have been tried upon the ores at Ingot and Bully Hill, where in late years zinc has become the principal metal. At present, California Zinc Company is operating a bulk flotation plant at Winthrop, where ore from both the Afterthought and Rising Star Mines is concentrated. The product carries 43% to 49% zinc, about 4% copper, 7% to 11% iron, 1.5% lead and 2.3% silica. It is shipped to Belgium for separation. During flotation treatment, about one-half the pyrite is dropped by alkalizing the pulp.

During the early years of development at Engels, the mine was separated by 26 miles of rough mountain road from the nearest point on the Western Pacific Railroad. A blast furnace was built in 1911, but was never used because of objections by the United States Forest Service. A minerals separation flotation plant was built in 1914 and has subsequently been enlarged to a working capacity of about 1000 tons a day, with an ultimate capacity of 1500 tons daily. The Indian Valley Railroad, 22 miles long, was built to the mine in 1916, being financed largely by the mining company. Concentrate carries 30% copper, 0.08 ounce gold and 8 ounces to 10 ounces silver per ton. This mine is at an elevation of 5263 feet in a well-timbered country.

Concentrate from the Walker Mine's flotation plant is delivered over their aerial tramway, nine miles long, to the Western Pacific Railroad at Spring Garden for shipment to the Utah smelter.

Besides these plants, Mountain Copper Company maintains a smelter at Martinez where they handle pyrite cinder for its copper content, after it has been treated for the manufacture of sulphuric acid. The ore comes from their Hornet Mine, in Shasta County.

Conclusion.

California copper mines operate at comparatively high costs. There is consequently no incentive for developing new properties with present market prices for copper, although conditions do justify the maintenance and operation of such plants as are now in commission. The copper production of the state in 1925, according to the records of the California State Mining Bureau, was mostly from three counties, whose principal active mines have been mentioned above, namely: Plumas County, 26,950,029 pounds; Shasta County, 14,565,967 pounds, and Calaveras County, 4,906,650 pounds. Production in Plumas County is increasing, and this district promises to continue as the largest producer for some time. The extent of the Plumas copper belt has not been outlined. The two principal mines are 17 miles apart, with many copper prospects but no real development between them. Shasta County has unexplored areas possibly containing future mines. Siskiyou County has two developed mines and numerous prospects, all too far from present railroads to be operated at the present price of copper. The mining regions of this county are all within the National Forests, where blast furnaces would not be permitted. A railroad is needed to open these mines.

Mention should be made of the numerous other copper possibilities of the state, there being a great number of small mines, only superficially developed, that can produce copper whenever the price may warrant.

ADMINISTRATIVE DIVISION.

WALTER W. BRADLEY, Deputy State Mineralogist.

Personnel.

There have been no changes of personnel to be noted during the past quarter.

New Publications.

During the quarterly period covered by this issue, the following Bureau publications have been made available for distribution:

Summary of Operations, California Oil Fields Vol. 11, Nos. 8 and 9, February and March, 1926, respectively.

Commercial Mineral Notes: Nos. 38, 39, 40, 41, April-July (inc.).

These 'notes' carry the lists of 'mineral deposits wanted' and 'minerals for sale,' issued in the form of a mimeographed sheet, monthly. It is mailed free of charge to those on the mailing list for 'Mining in California.'

Mails and Files.

The Bureau maintains in addition to its correspondence file and the library, a mine report file which includes reports on some 7,500 mines and mineral properties in California.

During the period covered by this quarterly report, there were 1768 letters received and answered at the San Francisco office alone, covering almost every phase of prospecting, mining and developing mineral deposits, reduction problems, and marketing of refined products.



DIVISION OF MINERALS AND STATISTICS.

Statistics, Museum, Laboratory.

WALTER W. BRADLEY, Deputy State Mineralogist.

STATISTICS.

Data on the 1925 production of several of California's minerals were given in the April issue of *MINING IN CALIFORNIA*, and some additional ones are presented herein. Copy of the complete annual report for that year is now being prepared and will shortly go to the printer, as Bulletin No. 97 of the State Mining Bureau.

COPPER.

Copper is second only to gold among the metals produced in California. The output for 1925 amounted to a total of 46,968,499 pounds of recoverable metal valued at \$6,669,527, a slight decrease from the 1924 figures of 52,089,349 pounds and \$6,823,704. The average price for 1925 being higher (14.2¢ against 13.1¢ per pound) than in 1924, the drop in total value was not as great in proportion as the decrease in quantity. The average price in 1923 was 14.7¢ per pound.

As for several years past, Plumas County ranked first for 1925 with an output of 26,950,029 pounds; Shasta, second, with 14,565,967 pounds; and Calaveras, third, with 4,906,650 pounds.

Distribution of the 1925 copper output, by counties, was as follows:

Copper Production, by Counties, 1925.

<i>County</i>	<i>Pounds</i>	<i>Value</i>
Calaveras -----	4,906,650	\$696,744
Inyo -----	73,003	10,367
Mono -----	1,020	145
Plumas -----	26,950,029	3,826,904
Riverside -----	23,134	3,285
San Bernardino -----	6,249	888
Shasta -----	14,565,967	2,068,367
Trinity -----	439,766	62,447
Amador, Butte, Kern, Lake, Los Angeles, Nevada, Orange, Placer* -----	2,681	380
Totals -----	46,968,499	\$6,669,527

* Combined to conceal output of a single operator in each.

GOLD

The production of gold in California in 1925 totaled 632,035.31 fine ounces, worth \$13,065,330, being a decrease of 4,104.41 fine ounces from the 1924 yield. This was divided, \$7,969,186 from the 'deep' or lode mines, and \$5,096,144 from placers (mainly by the dredgers). As the State Mining Bureau has never independently gathered the statistics of gold and silver production, these figures, as in former years, are published by cooperation with and through the courtesy of Mr. J. M. Hill of the Division of Minerals and Statistics, U. S. Bureau of Mines.

The largest gold production for 1925 is reported from Yuba County, with an output of 124,354.23 fine ounces (\$2,570,630); Amador County with 113,105.63 ounces (\$2,338,101), was second; Nevada County, with 111,533.74 ounces (\$2,305,607), third; followed by Sierra and Sacramento in fourth and fifth places respectively. It will be noted that Yuba County regained its place in first rank which it surrendered to Nevada

County in 1924. The Yuba County production is almost entirely from dredges, while that from Nevada County is mainly lode gold.

Distribution of the 1925 gold production, by counties, was as follows:

Gold Production, by Counties, 1925.		Value
County		
Alpine	-----	\$219
Amador	-----	2,338,101
Butte	-----	355,289
Calaveras	-----	652,433
Del Norte	-----	681
El Dorado	-----	40,212
Fresno	-----	25,056
Humboldt	-----	13,142
Inyo	-----	43,774
Kern	-----	135,545
Lassen	-----	1,130
Los Angeles	-----	409
Madera	-----	2,366
Mariposa	-----	192,810
Merced	-----	289
Mono	-----	5,503
Monterey	-----	998
Napa	-----	195
Nevada	-----	2,305,607
Orange	-----	52
Placer	-----	121,785
Plumas	-----	249,540
Riverside	-----	3,687
Sacramento	-----	1,302,320
San Bernardino	-----	157,374
San Diego	-----	5,134
San Luis Obispo	-----	840
Shasta	-----	235,013
Sierra	-----	1,373,705
Siskiyou	-----	180,120
Stanislaus	-----	171,742
Trinity	-----	424,037
Tuolumne	-----	155,592
Yuba	-----	2,570,630
Total value	-----	\$13,065,330

LEAD.

Production of lead in California in 1925 increased approximately 40% in quantity and 60% in value over the preceding year. As in the past, the principal output was from lead-silver ores in Inyo County. The total recoverable lead in ores shipped from Californian mines in 1925 amounted to 7,352,422 pounds valued at \$639,661, compared with 4,984,387 pounds and \$398,751 in 1924. This, in turn, however, was slightly less than the 1923 yield. The average price of lead in 1925 was 8.7¢ per pound as against 8.0¢ in 1924, 7.0¢ in 1923, and 3.9¢ in 1913.

The 1925 production was distributed by counties as follows:

Lead Production, by Counties, 1925.		Value
County	Pounds	
Inyo	6,301,105	\$548,196
Mono	22,488	1,957
Riverside	135,872	11,821
San Bernardino	61,480	5,349
Shasta	647,886	56,366
Amador, Butte, Calaveras, Los Angeles, Nevada, Orange *	183,591	15,972
Totals	7,352,422	\$639,661

* Combined to conceal output of a single operator in each.

NATURAL GAS.

Statistics on the production of natural gas in California are in a considerable degree difficult to arrive at, as much of it that is utilized directly at the wells for heating, lighting, and driving gas engines is not measured. Hence, it is necessary to approximate the output of

many of the operators in the oil fields, estimated on the number of lights, and on the number and horsepower of gas engines and steam boilers thus operated. The figures here given are for gas utilized locally and also that sold for distribution to consumers; and we consider are not over-estimated, particularly in the six oil-producing counties. It must be remembered that several of our important oil fields are removed many miles from the site of any other industry, and that the gathering of small amounts of gas and transporting it for any considerable distance may not always be profitable, nor is it often possible to have pipe-line facilities available to handle the gas accompanying the early gas production in newly developed fields. Wherever feasible, casing-head gas is used in driving gas engines for pumping and drilling, and in firing the boilers of steam-driven plants.

The most notable gas developments in California in recent years have been in the Elk Hills and Buena Vista Hills in Kern County, north-east of the Midway district, and in the new oil fields in the Los Angeles basin, Los Angeles and Orange counties.

Production and Value.

There is rather a wide variation in prices quoted for natural gas because a considerable part is used directly in the field for driving gas engines and firing boilers, and is therefore not measured nor sold. Such companies as have placed a valuation on the gas that was thus used in 1925 gave from 3¢-25¢ per 1000 cubic feet, at the well. From the totals shown in the tabulation following herein, the average value for all fields in 1925 works out at approximately 8.2¢.

Approximately 7000 cubic feet of gas is equal to one barrel of oil in heating value, and is so accounted for by many operators. In driving gas engines, about 4000 cu. ft. per 24 hr. are consumed by a 25-h.p. engine and 63,700 cu. ft. per day for heating a 70-h.p. steam boiler, which figures have been utilized in compiling this report, in those cases where gas was not metered.

Natural Gas 'Consumed,' or Utilized for Fuel, 1925.

County	M cu. ft.	Value
Fresno -----	1,515,889	\$116,711
Kern -----	45,649,845	2,290,608
Kings -----	740	440
Los Angeles -----	98,226,700	8,704,894
Orange -----	26,324,369	2,324,014
Santa Barbara -----	2,545,208	248,708
Tulare -----	280	175
Ventura -----	20,144,646	1,953,163
Butte, Humboldt, Lake, Mendocino, Sacra- mento, San Joaquin, San Luis Obispo, San Mateo, Santa Clara, Sutter, Yuba * -	312,247	251,369
Totals -----	194,719,924	\$15,890,082

* Combined to conceal output of a single operator in each.

The above totals for 1925 compare with 209,921,596 cu. ft., valued at \$15,153,140 in 1924. The only important increase in quantity in 1925 was made by Ventura County, which shows 20,144,646 M cu. ft. worth \$1,953,163 as against 5,995,760 M cu. ft. and \$633,352 in 1924. This was due to exploitation of deeper oil sands in the Ventura field. Fresno County showed a slight increase, Los Angeles, Orange, and Kern counties, in the order named, utilized somewhat smaller quantities of natural gas; but, with the exception of Los Angeles, there was a larger recovery of natural-gas gasoline from the gas treated.

Gasoline from Natural Gas.

More or less gas usually accompanies the crude petroleum in the oil fields, and such gas carries varying amounts of gasoline. A total of 163 plants by 83 operating companies or individuals were in operation in 1925 recovering gasoline by compression or absorption from this 'casing-head' gas. After the gasoline is extracted the remaining 'dry gas' so far as practicable is taken into pipe lines, by which it is distributed to consumers, both domestic and commercial.

In certain of the oil fields, some of the casing-head gasoline is obtained as an incidental product to the compressing of the natural gas preliminary to its transmission to consuming centers through the gas pipelines. Some concerns market the casing-head gasoline separately, others blend it with distillery gasoline, while others turn it into the oil pipelines, thus mixing this high-gravity gasoline with the crude oil for transportation to the refinery where it is later regained. A total of 301,755,000 gallons of casing-head gasoline valued at \$39,288,500 from all fields was reported as made during 1925, compared with 228,781,000 gallons valued at \$22,269,955 by 82 operators and 137 plants in 1924. It was distributed by counties, as follows:

Natural-Gas Gasoline Recovered, 1925.

<i>County</i>	<i>No. Plants</i>	<i>Gallons</i>	<i>Value</i>
Fresno -----	1	587,000	\$76,427
Kern -----	44	59,030,000	7,685,706
Los Angeles -----	76	177,920,000	23,165,184
Orange -----	29	45,040,000	5,864,208
Santa Barbara -----	4	6,891,000	897,208
Ventura -----	9	12,287,000	1,599,767
Totals -----	163	301,755,000	\$39,288,500

The usual recoveries of gasoline from natural gas vary from $\frac{1}{2}$ gal. to 3 gal. per 1000 cu. ft. of gas handled, the average being about 1 gal. per 1000 cu. ft. A recent report by Mashaw & Swanson¹ gives the average recovery for 1925 as 1.281 gallons per 1000 cu. ft. of gas treated. Their figures show the following production, by methods:

Natural-Gas Gasoline Production, 1925, by Methods.

(Per U. S. Bureau of Mines)

<i>Method</i>	<i>Gallons</i>	<i>Recovery (Gal. per M cu. ft.)</i>
Oil absorption -----	176,659,197	1.117
Compressor -----	6,718,091	1.369
Combination compressor and oil absorption -----	86,156,130	1.436
Combination oil and charcoal absorption -----	33,367,546	1.539
Drip -----	279,113	----
Totals -----	303,180,077	1.281

PETROLEUM.

The crude oil production of California for 1925 amounted to a total of 232,492,147 barrels of clean oil, valued at \$330,609,829 at the well. This total of quantity is compiled from the monthly production reports filed by the operators with the State Oil and Gas Supervisor, to which have been added figures for the output of a number of small operators in the old Los Angeles City Field not under the jurisdiction of the Supervisor, and a small production in San Mateo County which was also not reported to that office.

¹ Mashaw, J. W., & Swanson, E. B., Statistical summary of the California petroleum industry 1925: U. S. Bureau of Mines, 1926, p. 27.

The question of the value of the crude oil yield at the well is a difficult one to settle with exactitude, principally because a large part of the output is not sold until after refining. The large refiners are also large producers of crude oil which they send direct from well to plant, hence much of the crude oil is not sold as such. The values used in the statistical reports of the State Mining Bureau since 1914 have been derived from averages of actual sales of crude oil of all grades in each field of the state, and these averages applied to the total yield of the respective fields. This we feel is a safer measure of commercial values than market quotations, because quotations do not always mean sales. This is particularly true on a rising or a falling market.

A comparison of the sales and quotations averages for the past ten years reveals a number of interesting developments, among which may be noted the following: On a rising market the average sales price for the year will be lower than the average of quotations; and on a falling market the average sales will be higher than the quotation average. This is probably due, in part at least, to sales under time contracts.

Features of 1925.

The noteworthy features of the year 1925 in the oil industry of California were the higher prices prevailing and the increase in production due to the newer fields of Inglewood, Rosecrans, Dominguez, and Ventura, though this increase was partly offset by the increased amount of closed-in production and partly by decline in some of the older fields, particularly Long Beach.

Summarizing the data for the year, the State Oil and Gas Supervisor¹ presented the following figures:

"The total production of the state for the last six months of 1925 was 120,623,010 barrels of oil and 53,519,125 barrels of water. The production of oil for the year 1925 was, therefore, 232,334,238 barrels, an increase of 3,625,767 barrels over 1924. Production increased, notwithstanding that the amount of closed-in production in the state increased during the latter half of the year. The increased production was principally from four fields as follows:

Field	Increase of 1925 over 1924 production
Inglewood -----	18,365,356 barrels
Rosecrans -----	7,191,880 barrels
Dominguez -----	6,767,640 barrels
Ventura -----	5,182,597 barrels
Total -----	37,507,473 barrels

This increase was partly offset by the increased amount of closed-in production, and partly by decline in some of the older fields, notably Long Beach, which produced 19,527,931 barrels less in 1925.

"The production of oil for the last half of 1925 was 8,911,782 barrels more than for the first half. Water production decreased 1,760,012 barrels during the same periods.

"The estimated closed-in production remained constant at about 25,000 barrels daily during the first five months of the year, but in June additional production from Elk Hills and Midway-Sunset was closed in, and the amount increased steadily in those and other fields to 60,454 barrels daily in December.

"Storage and Price Changes.

"The total crude and refined petroleum in storage in Pacific coast territory at the end of 1925 was 153,796,682 barrels according to the American Petroleum Institute. The increase in storage during the year amounted to 28,774,718 barrels compared with an increase in 1924 of 8,294,522 barrels. The total amount of crude and refined oil shipped to eastern ports during 1925 was 27,937,000 barrels or 19,690,000 barrels less than the 1924 shipments.

"Prices of crude averaged higher in 1925 than in 1924. The prevailing price range of \$1 to \$1.82 per barrel in January was increased in February to a range of \$1.25 to \$2.40 per barrel and continued at that level until September 21, when it was reduced, ranging from \$0.90 to \$2.30 per barrel. A further reduction was made October 27 when the range in price was \$0.75 to \$2.30, affecting only the heavier grades. These prices continued for the remainder of the year.

¹ Bush, R. D., Resumé of oil field operations in California in 1925: Cal. State Min. Bur., 11th Ann. Rep. of State O. & G. Super. No 8, Feb. 1926, pp. 5 and 6.

"Drilling and Development.

"During 1925, 1359 wells were reported to the State Oil and Gas Supervisor as ready to drill, as compared with 1352 new wells in 1924. Of the total number 107, or 8 per cent, were wildcat wells. No new fields of importance were discovered, but considerable new producing area was added by extensions of the Long Beach and Midway fields. A small amount of oil was discovered at Seal Beach, Los Angeles County; in Sonoma County, near Petaluma; and in Monterey County, southwest of Salinas. New and deeper producing horizons were discovered in the Brea-Olinda, Sunset, and Cat Canyon fields."

Outlook for 1926.

Figures for the first six months of 1926 indicate a slight decline in yield for the current year compared with 1925. Production has dropped to around 610,000 barrels per day from the 1925 average of 634,000 barrels daily. Effective March 11th, prices were advanced for the lighter grades of crude oil.

Production Figures.

The following table gives the production and value by counties for 1925, compared with the 1924 figures:

Production and Value of Crude Oil, by Counties.

County	1924		1925	
	Barrels	Value	Barrels	Value
Fresno -----	10,156,405	\$11,801,743	7,773,665	\$8,503,390
Kern -----	61,175,405	69,572,934	58,852,742	84,255,094
Los Angeles -----	119,027,428	147,474,953	121,214,551	173,215,593
Orange -----	31,661,283	37,455,298	32,734,420	46,384,673
San Luis Obispo -----	31,222	30,972	29,590	32,164
Santa Barbara -----	2,905,181	3,009,768	2,647,380	2,419,705
Santa Clara -----	14,417	20,481	13,828	22,594
Ventura -----	3,958,010	5,279,985	9,221,846	15,769,357
San Bernardino and San Mateo -----	^a 4,120	6,740	^b 4,125	7,259
	228,933,471	\$274,652,874	232,492,147	\$330,609,829

^a Combined to conceal output of a single operator in each.

^b Combined to conceal output of a single operator in San Bernardino County.

The foregoing totals show a state average price of \$1.422 per barrel for the year 1925, as compared to \$1.200 in 1924 and \$0.923 in 1923.

Oil in 'Storage.'

Field, refinery, pipe-line, and tank-farm stocks of crude and refinery products in Pacific Coast territory totaled 153,795,682 barrels,¹ December 31, 1925, compared with 125,021,964 barrels on December 31, 1924, distributed as follows:

Stocks	Dec. 31, 1925	Dec. 31, 1924
Heavy Crude, heavier than 20° A.P.I., including all grades of fuel -----	(Barrels) 82,849,057	(Barrels) 57,254,796
Refinable Crude, 20° A.P.I., and lighter -----	44,345,837	40,574,578
Gasoline -----	10,172,562	10,957,487
Naphtha Distillates -----	6,548,483	9,346,613
All other stocks -----	9,879,743	6,838,490
Totals, all stocks -----	153,795,682	125,021,964

Proved Oil Land.

The total proved oil land of the state increased to 121,436 acres, as against 118,979 acres in 1924. Of this 1925 total, 22,673 acres being owned by Federal, State, and City governments, or for other reasons, is not assessable for the support of the Department of Petroleum and Gas of the State Mining Bureau. The acreage in 1925 was distributed by counties as follows:

¹ Standard Oil Bulletin, February, 1926, p. 13.

Proved Oil Land and Number of Wells, 1925.

County	Land (Acres)	Number wells
Fresno	14,636	969
Kern	76,398	5,931
Los Angeles*	11,239	2,807
Orange	6,630	979
San Bernardino		1
San Luis Obispo	402	11
San Mateo		3
Santa Barbara	7,823	354
Santa Clara	80	9
Ventura	4,228	571
Totals	121,436	11,635

* Not including the old Los Angeles City Field.

SALT.

Most of the salt production in California is obtained by evaporating the water of the Pacific Ocean, plants being located on the shores of San Francisco, Monterey, and San Diego bays, and at Long Beach. Additional amounts are derived from lakes and lake beds in the desert regions, mainly in Kern and San Bernardino counties. A small amount of valuable medicinal salts is obtained by evaporation of the water of Mono Lake, Mono County.

Distribution of the 1925 salt production of California, by counties, was as follows:

Salt Production, by Counties, 1925.

County	Tons	Value
Alameda	180,712	\$497,692
Kern	6,890	28,858
San Bernardino	28,319	101,085
San Mateo	31,325	155,925
Los Angeles, Modoc, Mono, ^a Monterey, San Diego ^b	36,822	166,266
Totals	284,068	\$949,826

^a Medicinal salts.

^b Combined to conceal output of a single operator in each.

The above returns show a decrease both in tonnage and value from the record figures of 1924 which were 318,800 tons and \$1,159,137. Slightly lower market prices prevailed during 1925, as a result of price cutting by one or two of the operators. As in 1924, there were nine plants operating in Alameda County in 1925, but a total of only eleven in the other counties tabulated (a decrease of one).

SILVER.

Except for the early-day production from the silver mines of the Calico district and the more recent production from those of the Randsburg area, both of which are in San Bernardino County, the recovery of silver in California has been largely as a by-product from its association with copper, lead, zinc, and gold ores.

The 1925 silver output of California totaled 3,054,416 fine ounces, valued at \$2,106,871, compared with 3,555,153 fine ounces valued at \$2,381,952 in 1924. Of the 1925 yield, \$12,894 was from placers. The average price of domestic silver during 1925 was 69.4¢ per ounce in New York, as against 67¢ in 1924, and \$1.00 in 1921-1923 under the Pittman Act. The figures below are those of the U. S. Bureau of Mines, Department of Commerce (as explained under Gold).

The distribution of the 1925 silver yield, by counties, was as follows:

Silver Production, by Counties, 1925.

County	Fine ounces	Value
Alpine	2	\$1
Amador	23,232	16,123
Butte	6,274	4,354
Calaveras	11,994	8,324
Del Norte	2	1
El Dorado	343	238
Fresno	217	151
Humboldt	90	62
Inyo	169,688	117,763
Kern	10,742	7,455
Lassen	34	24
Los Angeles	22,254	15,444
Madera	118	82
Mariposa	2,533	1,758
Merced	2	1
Mono	2,291	1,590
Monterey	4	3
Napa	2,046	1,420
Nevada	46,333	32,155
Orange	1,433	995
Placer	893	620
Plumas	423,997	294,254
Riverside	3,703	2,570
Sacramento	2,767	1,920
San Bernardino	1,986,155	1,378,392
San Diego	83	58
San Luis Obispo	10	7
Shasta	300,890	208,818
Sierra	12,852	8,919
Siskiyou	1,198	831
Stanislaus	1,000	694
Trinity	11,129	7,724
Tuolumne	885	614
Yuba	9,222	6,400
Totals	3,054,416	\$2,119,765

SOAPSTONE AND TALC.

The total output of tale and soapstone in California in 1925 amounted to 15,465 tons valued at \$239,084, compared with 16,179 tons valued at \$242,770 in 1924. Nearly 80% of the product was high-grade tale from Inyo and San Bernardino counties, which material was utilized mainly in toilet powders, paint, paper, and rubber manufacture, and some in ceramics. The 'soapstone' grades were used mainly for roofing granules and as a filler in roofing paper, and part also in magnesite cement.

It is reported that Californian tale is steadily replacing imported tale in the toilet trade on the basis of quality. The largest production of tale in the United States comes from Vermont and New York, and of massive soapstone from Virginia. Foreign importations of high-grade white tale suitable for manufacture of toilet powder have come mainly from Canada, Italy, and France. Foreign producers have the benefit of cheap labor, and a low tariff import duty.

SODA.

The production of carbonates and sulphate of sodium in California in 1925 included: soda ash and bicarbonate from plants at Owens Lake, Inyo County; trona ('sesqui-carbonate,' a double salt of Na_2CO_3 and NaHCO_3) from Searles Lake, San Bernardino County; and salt cake (sulphate) from the Carrizo Plains, San Luis Obispo County. The total amounted to 48,625 tons valued at \$947,649, being an increase in

both quantity and value compared with the 1924 figures of 32,536 tons and \$711,796.

The dense ash and bicarbonate were used mainly in the manufacture of soap, glass, and chemicals; the salt cake in paper making; and the trona for metallurgical purposes.

TUNGSTEN.

The commercial production of tungsten ores and concentrates in California began in 1905; and has been continuous since, with the exception of 1920-1922 (inclusive), when the mines were shut down owing to low prices due to excess stocks following the war and to lack of tariff protection against foreign importations. Production was resumed on a small scale late in 1923, and has now practically regained its pre-war average annual tonnage, though the 1925 figures are about 25% less than those for 1924.

The material shipped in 1925 included both high-grade sorted ore and concentrates, coming from properties in Inyo and San Bernardino counties. A total of 8619 tons of all grades was reported produced, and in part concentrated, yielding 573 tons recalculated to 60% WO_3 , valued at a total of \$348,471.

Prices during 1925 ranged rather regularly from \$9.00 per unit, duty paid, for Chinese wolframite in January, to \$12.00 in December; with domestic scheelite commanding 50¢ to \$1.00 per unit higher. Present (July, 1926) prices are \$11.75 to \$12.75, with domestic demand light, though curtailment of Chinese supplies is anticipated.

ZINC.

Recoverable zinc in ores mined in California in 1925 amounted to 11,546,602 pounds valued at \$877,542, compared with 3,060,000 pounds and \$198,900 in 1924. The 1924 output was marketed entirely in the form of the oxide; but the major portion of the 1925 yield (in the form of concentrates) was shipped to Belgium for treatment. A small amount of oxide was marketed.

The average price per pound quoted for the metal in 1925 was 7.6¢ as against 6.5¢ in 1924.

MUSEUM.

The Museum of the State Mining Bureau possesses an exceptionally fine collection of rocks and minerals of both economic and academic value. It ranks among the first five of such collections in North America; and contains not only specimens of most of the known minerals found in California, but much valuable and interesting material from other states and foreign countries as well.

Mineral specimens suitable for exhibit purposes are solicited, and their donation will be appreciated by the State Mining Bureau as well as by those who utilize the facilities of the collection.

The exhibit is daily visited by engineers, students, business men, and prospectors as well as tourists and mere sightseers. Besides its practical use in the economic development of California's mineral resources, the collection is a most valuable educational asset to the state and to San Francisco.

LABORATORY.

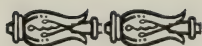
FRANK SANBORN, Mineral Technologist.

Sericite mica-schist samples from Inyo and other counties in the state are frequently received at this laboratory for identification. It has been stated that these schists, which resemble talc in feel and general appearance, occur in large deposits. The fact that sericite mica contains alumina up to 38%, and potash up to 11% suggests the possibility of these schists being a potential source of potash with a residue suitable for use in the cement or ceramic industries.

As far back as 1857 a patent was taken out for extracting potash from feldspar, lava, etc., by mixing them with fluorite or calcium carbonate and heating to bright redness; the alkali being subsequently extracted from the mass by leaching with boiling water.

A number of methods of extracting potash from feldspar have been tried with partial success, but apparently unless the residue can also be utilized commercially, the costs of extracting the potash are too high for a profitable recovery of potash alone. In the case of sericite mica-schist the mining and treatment costs would probably be much less than they would be for feldspar, and a residue obtained that could be utilized in ceramics or cement making.

A total of 1293 samples were received during the four-month period covered by this report. Requests for the identifications come from practically every county in the state.



LIBRARY.

FOREST L. CAMPBELL, Librarian.

In addition to the numerous standard works, authoritative information on many phases of the mining and mineral industry is constantly being issued in the form of reports and bulletins by various government agencies.

The library of the State Mining Bureau contains some five thousand selected volumes on mines, mining and allied subjects, and it is also a repository for reports and bulletins of the technical departments of federal and state governments and of educational institutions, both domestic and foreign.

It is not the dearth of the latter publications, but rather a lack of knowledge of just what has been published and where the reports may be consulted or obtained, that embarrasses the ordinary person seeking specific information.

To assist in making the public acquainted with this valuable source of current technical information, 'Mining in California' contains under this heading a list of all books and official reports and bulletins received, with names of publishers or issuing departments.

Files of all the leading technical journals will be found in the library, and county and state maps, topographical sheets and geological folios. Current copies of local newspapers published in the mining centers of the State are available for reference.

The library and reading room are open to the public during the usual office hours, when the librarian may be freely called upon for all necessary assistance.

OFFICIAL PUBLICATIONS RECEIVED.

Governmental.

U. S. Geological Survey:

- Bulletin 768—Geology and Oil Resources of the Puente Hills Region, Southern California. By W. A. English.
- Bulletin 776—The Mesozoic Stratigraphy of Alaska. By George C. Martin.
- Bulletin 779—Guides to Ore in the Leadville District, Colorado. By G. F. Loughlin.
- Bulletin 783-A—Mineral Industry of Alaska in 1924 and Administrative Report. By P. S. Smith.
- Bulletin 783-B—Mineral Investigations in Southeastern Alaska. By A. F. Buddington.
- Bulletin 783-D—The Nixon Fork Country and Silver-Lead Prospects near Ruby. By J. S. Brown.
- Bulletin 785-B—Potash Investigations in 1924. By W. B. Lang.
- Professional Paper 139—Geology and Ore Deposits of the Ducktown Mining District, Tennessee. By W. H. Emmons.
- Professional Paper 140—Shorter Contributions to General Geology 1925. By W. C. Mendenhall.
- Professional Paper 143—Paleontology and Stratigraphy of the Castle Hayne and Trent Marls in North Carolina. By L. B. Kellum.
- Professional Paper 145—Geology and Oil and Coal Resources of the Oregon Basin and Grass Creek Basin Quadrangles, Wyoming. By D. F. Hewett.
- Water Supply Paper 558—Preliminary Index to River Surveys made by the United States Geological Survey and Other Agencies. By B. E. Jones.
- Water Supply Paper 562—South Atlantic Slope and Eastern Gulf of Mexico Basins. By Nathan C. Grover.

U. S. Bureau of Mines:

Bulletin 252—Beneficiation and Utilization of Georgia clays. By R. T. Stull.
Mineral Resources of the United States:

Natural Gas in 1924.

Gold, Silver, Copper, and Lead in Arizona in 1924.

Barytes and Barium Products in 1924.

Natural-Gas Gasoline in 1924.

Stone in 1924.

Fuel Briquetts in 1925.

Technical Paper 363—Analysis of Virginia Coals. By J. B. Eby.

Technical Paper 365—Lessons from the fire in the Argonaut Mine. By B. O. Pickard.

Technical Paper 356—Analyses of Tennessee Coals. By Wilbur A. Nelson.

Technical Paper 377—Red Iron Ores and Ferruginous Sandstones of the Clinton Formation in the Birmingham District, Alabama. By W. R. Crane.

Technical Paper 382—Accidents in the California Petroleum Industry in 1923.

Technical Paper 395—Accidents at the Metallurgical Works in the United States during the Calendar Year 1925. By W. W. Adams.

Reports of Investigations:

Serial No. 2743—Coal Mining Royalties and Leasing Conditions in Vermilion and Edgar Counties, Illinois (District VIII). By L. D. Tracy.

Serial No. 2744—Flotation of Limestone from Siliceous Gangue. By Oscar Lee.

Serial No. 2745—Tests and Characteristics of Dust Respirators. By S. H. Katz, G. W. Smith, and E. G. Meiter.

Serial No. 2746—Sanitary Survey of the Coal Mines of Alabama. By F. V. Meriwether.

Serial No. 2747—Study of the Reactions in an Iron Blast Furnace. By S. P. Kinney, P. H. Royster, and T. L. Joseph.

Serial No. 2748—Consumption of Explosives in March, 1926. By W. W. Adams.

Serial No. 2749—Coal-Mine Fatalities in March, 1926. By W. W. Adams.

Serial No. 2750—Gas Mask for Protection Against Ammonia Gas. By A. C. Fieldner, S. H. Katz, and H. W. Frevert.

Serial No. 2751—Nomographic Charts for Computing the Rate of Leakage from Natural Gas Lines. By E. O. Bennett.

Serial No. 2752—Methods of Testing High-Pressure Natural-Gas Lines for Leakage Losses. By E. L. Rawlins.

Serial No. 2753—Consumption of Explosives in April, 1926. By W. W. Adams.

Serial No. 2754—Coal-Mine Fatalities in April, 1926. By W. W. Adams.

Serial No. 2755—The Sizing Action of a Coal-Washing Table. By Byron M. Bird.

Serial No. 2756—Subject List of Reports of Investigations Issued During 1925.

Serial No. 2757—Extinction of Methane Flames by Helium. By H. F. Coward and G. W. Jones.

Serial No. 2758—Explosibility of Oil-Shale Dust. By Vernon C. Allison and Arthur D. Bauer.

Serial No. 2759—Consumption of Explosives in May, 1926. By W. W. Adams.

Serial No. 2760—Coal-Mine Fatalities in May, 1926. By W. W. Adams.

Serial No. 2761—Magnetic Concentration of Flue Dust of the Birmingham District. By Oscar Lee, B. W. Gandrud, and F. D. DeVaney.

Serial No. 2762—Manufacture of Lime from Small Stone with a Sintering Machine. By W. M. Myers.

Serial No. 2763—Coal-Mine Fatalities in June, 1926. By W. W. Adams.

Serial No. 2764—Consumption of Explosives in June, 1926. By W. W. Adams.

Information Circulars:

Circular No. 6004—Record of the Pittsburgh Testing Station Standard Dynamite. By S. P. Howell.

Circular No. 6006—Manufacture and Characteristics of Gasoline. By A. J. Kraemer.

Circular No. 6007—The Quicksilver Situation from a Domestic Standpoint. By J. W. Furness and R. M. Santmyers.

- Circular No. 6008—Rock Dust Material for Coal Mines.
Circular No. 6009—Gases Commonly Used in the Industries and the Home and Their Hazards. By A. C. Fieldner.
Circular No. 6010—Leakage Losses from Pipe Lines Carrying Natural Gas Under High Pressures. By E. L. Rawlins.
Circular No. 6011—The Movement of Oil Through the Panama Canal. By G. R. Hopkins.
- Connecticut Geological and Natural History Survey: Bulletin 33—The Geology of the Stonington Region, Connecticut. By L. H. Martin.
- Idaho Inspector of Mines: Twenty-seventh Annual Report of the Mining Industry in Idaho for the year 1925.
- Bureau of Mines and Geology:
Pamphlet 15—Ground Water for Irrigation on Camas Prairie, Camas and Elmore Counties, Idaho. By A. M. Piper.
Pamphlet No. 16—Ground Water for Municipal Supply at Idaho Falls, Idaho. By A. M. Piper.
- Illinois State Geological Survey:
Bulletin 47—Geology and Mineral Resources of the Equality Shawneetown Area. By Chas. Butts.
Bulletin 50—Natural Bonded Molding Sand Resources of Illinois. By M. S. Littlefield.
Bulletin 52—Pennsylvania Flora of Northern Illinois. By A. C. Noe.
Bulletin 48—Geology and Mineral Resources of the Carbondale Quadrangle. By J. E. Lamar.
Bulletin 51—Geology and Mineral Resources of the Joliet Quadrangle.
- Reports of Investigations:
No. 8—Preliminary Report on the Economic Mineral Resources of Calhoun County. By J. E. Lamar.
No. 9—The Glenwood Beds as a Horizon Marker at the Base of the Platteville Formation. By Arthur Bevan.
- Indiana Department of Conservation: Seventh Annual Report for the year ending September 30, 1925.
Kaolin of Indiana. By W. N. Logan.
Division of Geology: No. 55—Geology of the Deep Wells of Indiana. By W. N. Logan.
- Kentucky Geological Survey:
The Clays of Kentucky. By W. R. Jillson.
Pamphlet No. 8—Fire Clays of Northeastern Kentucky. By W. R. Jillson.
- Michigan Geological Survey Division: Pub. 36—Clays and Shales of Michigan. By G. G. Brown.
- Minnesota Geological Survey: Bulletin 21—The Geology and Magnetite Deposits of Northern St. Louis County. By Frank F. Grout.
- Mississippi State Geological Survey: Bulletin 20—Geology and Mineral Resources of Mississippi. By E. N. Lowe.
- Ohio Topographic Survey: Final Report on Land Subdivision, Vol. 3, 1925.
- Oklahoma Geological Survey:
Bulletin 31—Criteria for the Recognition of Heavy Minerals Occurring in the Mid-Continent Field. By F. C. Edson.
Bulletin 36—Petroleum Engineering in the Papoose Oil Field. By John R. Dunn.
Bulletin 37—Geology of Texas County, Oklahoma. By Chas. N. Gould.
- Pennsylvania Topographic and Geologic Survey:
Bulletin M6—Bituminous Coal Fields of Pennsylvania. By J. D. Sisler.
Bulletin M7—Limestone of Pennsylvania. By B. L. Miller.
- Tennessee Division of Geology: Bulletin 33-B—The Northern Tennessee Coal Field. By L. C. Glenn.
- Washington Department of Conservation and Development: Report of Investigation No. 1—Abstract of the Report on the Geology and Resources of the Pasco and Prosser Quadrangles. By H. E. Culver.
- Wisconsin Geological and Natural History Survey: Bulletin 56-A—Soil Survey of Milwaukee County, Wisconsin. By A. R. Whitson, et al.
- California Highway Commission: Important Statutes Relating to the California Highway Commission, compiled Nov., 1925.
- California Industrial Accident Commission: Report of the Industrial Accident Commission of the State of California from July 1, 1924, to June 30, 1925.

Argentina Ministerio de Agricultura:

- Pub. 12—Informe sobre un Yacimiento de Mineral de Hierro en la Sierra de Paganzo. By Roberto Beder.
- Pub. 13—Las Termas de Rosario de la Frontera. By Juan Rassmuss.
- Pub. 14—Contribucion al Estudio de las Fuentes Termo—Minerales de Rosario de la Frontera. By Hercules Corti.
- Pub. 15—La Laguna de Epecuen. By Hercules Corti.
- Pub. 16—Las Concretiones de Mineral de Manganeseo de Puerta Quemada, Dpto. de Burruyacu. By Roberto Beder.

Canada Department of Mines:

- Memoir 144—Mount Albert Map-area, Quebec. By F. J. Alcock.
- Economic Geology Series No. 1—Geology and Economic Minerals of Canada. By G. A. Young.
- Summary Report, 1924, Part B.
- Report of the Department of Mines for the Fiscal Year Ending March 31, 1925.
- Bulletin 55—Preliminary Report on the Mineral Production of Ontario in 1925.
- Memoir 143—North Shore of Lake Huron. By W. H. Collins.
- Museum Bulletin No. 40—Birds Collected and Observed During the Cruise of the Thiepval in the North Pacific, 1924. By H. M. Laing.

Ontario Department of Mines: 33rd Annual Report, 1924, Parts I to VII.

- Final Report of the Peat Committee appointed jointly by the Governments of the Dominion of Canada and the province of Ontario. By B. F. Haanel.

Great Britain Geological Survey:

- Summary of Progress of the Geological Survey of Great Britain and the Museum of Practical Geology for the year 1925.
- The Geology of the Carlisle, Longtown and Silloth District. By E. E. L. Dixon, et al.
- Central Coalfield of Scotland.

New Zealand Bureau of Mines: Bulletin 27—The Geology of the Whangarei-Bay of Islands Subdivision, Kaipara Division. By H. T. Ferrar.**Russia Institute of Economic Mineralogy and Metallurgy:**

- No. 19—The Jourawlinsee Bauxit-Deposit.
- No. 20—The Jourawlinsee Bauxit-Deposit.
- No. 21—The Metallogenous Epochs and Regions of Siberia.
- No. 24—Cordierite Granulites and Kelyphytic Structure.
- No. 28—Essays of Economical Costs Calculation for our Aluminum Home Works Plant and Aluminum's Production Cost.

South Australia Department of Mines: Mining Review for the half year ended December 31, 1925.**Victoria Geological Survey, Australia:**

- Memoir 15—The Aberfeldy District, Gippsland. By W. Baragwanath.
- Records of the Geological Survey of Victoria, Vol. 4, No. 4.
- Bulletin 44—Bright, Wandiligong and Freeburgh Goldfields. By J. P. L. Kenny.

Transvaal Chamber of Mines:

- 36th Annual Report for the year 1925.
- Reports of the Executive, Gold Producers and Collieries Committees for the year 1925.

Geological Institute of South Manchuria R. R. Co.: Explanatory Text to the Geological Map of Manchuria.**Societies and Educational Institutions.****California, University of:**

- Bulletin of the Department of Geological Sciences, Vol. 16, No. 4—Cassididae of Western America. By H. G. Schenck.
- Publications in Engineering:
- Vol. 2, No. 8—Theory of Aeroplane Structural Members Subjected to Combined Axial and Non-Uniform Transverse Loads. By J. E. Younger.
- Vol. 2, No. 7—An Investigation of the Influence of Pitch on the Performance of an Air Propeller when its Slipstream is Obstructed. By B. M. Woods.
- Bulletin of the Department of Geological Sciences, Vol. 16, No. 3—Anchitheriine Horses from the Fish Lake Valley Region, Nevada. By Chester Stock.

- McGill University, Montreal: Announcement of the Faculty of Applied Science for the Season 1926-27.
- Oklahoma, University of: Bulletin of the College of Engineering for 1926.
- Oregon, University of: Mount Multnomah, Ancient Ancestor of the Three Sisters. By E. T. Hodge.
- Real Academia de Ciencias y Artes de Barcelona: Num. 12—Monographia de los Tipulados de las Islas Canarias. By Dr. E. S. Abreu.
- Tokyo, Imperial University of:
The Mineralization in the Susaki Mine in the Province of Idzer. By T. Kato. Journal of the Faculty of Science, Vol. 1, Parts 2, 5, and 6.
- Musau Nacional de Rio de Janeiro—Archivos, Vol. XXV.
- Library of Congress: Report of the Librarian of Congress for the Fiscal Year Ending June 30, 1925.
- California Academy of Sciences:
Proceedings:
Vol. II, Part II, No. 18.
Vol. IV, Nos. 18, 19, 20.
Vol. XII.
Vol. XIII.
Vol. XV, Nos. 1 to 11.
- Field Museum of Natural History: Publication 235—Annual Report of the Director to the Board of Trustees for the year 1925.
- Philadelphia, Academy of Natural Sciences of: Yearbook for the year ending December 31, 1925.

Books.

- Potash. By J. W. Turrentine.
- Handbook of Non-Ferrous Metallurgy. 2 Vols. By Liddell.
- Stainless Iron and Steel. By Monypenny.

Maps.

Topographic Maps:

- | | |
|-------------------------|--------------------------------------|
| Bell, Cal. | Lahaina, T. H. |
| Cave-in-Rock, Ky.-Ill. | Martinsville, Va.-N. C. |
| Centerpoint, W. Va. | Mingo, W. Va. |
| Clearwater, Cal. | San Joaquin, Cal. |
| East Columbus, Ohio. | Towanda, Pa.-N. Y. |
| Edgeley, N. Dak. | Waldo Lake, Ore. |
| Gravelly Springs, Ala. | Washtucna, Wash. |
| Havana, Ill. | Wheeler, Wash. |
| Jay Peak, Vt. | Yorkville, Ill. |
| Alhambra, Cal. | Great Smoky Mountains National Park, |
| Bluefield, West Va.-Va. | N. C.-Tenn. |
| Bradford, Pa.-N. Y. | Hollywood, Cal. |
| Burnham, Maine. | La Farge, Wis. |
| Deposit, N. Y. | Laurel, Md. |
| Fairmont, W. Va. | Mannington, W. Va. |
| Gays Mills, Wis. | Shenandoah National Park, Va. |
| Dry Canyon, Cal. | Viroqua, Wis. |
| Zelzah, Cal. | Elk Hills Naval Reserve No. 1, Cal. |
| Sylmar, Cal. | |

Current Magazines on File.

For the convenience of persons wishing to consult the technical magazines in the reading room, a list of those on file is appended:

- American Petroleum Institute, New York.
- Architect and Engineer, San Francisco.
- Arizona Mining Journal, Phoenix, Arizona.
- Asbestos, Philadelphia, Pennsylvania.
- Brick and Clay Record, Chicago.
- Bulletin, Union Oil Co., Los Angeles.
- California Journal of Development, San Francisco.
- Cement, Mill and Quarry, Chicago, Illinois.

Chemical-Engineering and Mining Review, Melbourne, Australia.
 Engineering and Mining Journal-Press, New York.
 Explosives Engineer, Wilmington, Del.
 Financial Insurance News, Los Angeles, California.
 Graphite, Jersey City.
 Journal of Electricity and Western Industry, San Francisco.
 Metallurgical and Chemical Engineering, New York.
 Mine and Quarry, Chicago.
 Mining and Engineering Record, Vancouver, B. C.
 Mining and Oil Bulletin, Los Angeles.
 Oil Age, Los Angeles.
 Oil and Gas Journal, Tulsa, Oklahoma.
 Oil and Gas News, Kansas City.
 Oil News, Galesburg, Illinois.
 Oildom, New York.
 Oil, Paint and Drug Reporter, New York.
 Oil Trade Journal, New York.
 Oil Weekly, Houston, Texas.
 Petroleum Age, New York.
 Petroleum Record, Los Angeles.
 Petroleum World, Los Angeles.
 Queensland Government Mining Journal, Brisbane, Australia.
 Rock Products, Chicago, Illinois.
 Safety News, Industrial Accident Commission, San Francisco.
 Salt Lake Mining Review, Salt Lake City, Utah.
 Southwest Builder and Contractor, Los Angeles.
 Standard Oil Bulletin, San Francisco.
 Stone, New York.
 The Record, Associated Oil Company, San Francisco.
 Through the Ages, Baltimore.

Newspapers.

The following papers are received and kept on file in the library:

Amador Dispatch, Jackson, Cal.
 Arkansas Oil and Mineral News, Hot Springs National Park (Arkansas).
 Barstow Printer, Barstow, Cal.
 Blythe Herald, Blythe, Cal.
 Bridgeport Chronicle-Union, Bridgeport, Mono Co., Cal.
 Calaveras Prospect, San Andreas, Cal.
 California Oil World, Los Angeles, Cal.
 Cloverdale Reveille, Cloverdale, Cal.
 Colusa Daily Sun, Colusa, Cal.
 Daily Commercial News, San Francisco, Cal.
 Daily Midway Driller, Taft, Cal.
 Del Norte Triplicate, Crescent City, Cal.
 Exeter Sun, Exeter, Cal.
 Gateway Gazette, Beaumont, Cal.
 Goldfield News, Goldfield, Nevada.
 Guerneville Times, Guerneville, Cal.
 Healdsburg Enterprise, Healdsburg, Cal.
 Humboldt Standard, Eureka, Cal.
 Inyo Independent, Independence, Cal.
 Inyo Register, Bishop, Cal.
 Ione Valley Echo, Ione, Cal.
 Lake County Bee, Lakeport, Cal.
 Mining and Financial Record, Denver, Colo.
 Mining Topics, San Francisco, Cal.
 Mountain Democrat, Placerville, Cal.
 Mountain Messenger, Downieville, Cal.
 Nevada Mining Press, Reno, Nevada.
 Oatman Mining News, Oatman, Arizona.
 Oregon Observer, Grants Pass, Oregon.
 Oroville Daily Register, Oroville, Cal.
 Petroleum Reporter, Taft, Cal.

Placer Herald, Auburn, Cal.
Plumas Independent, Quincy, Cal.
Plumas National Bulletin, Quincy, Cal.
Randsburg Times, Randsburg, Cal.
San Diego News, San Diego, Cal.
Shasta Courier, Redding, Cal.
Siskiyou News, Yreka, Cal.
Stockton Record, Stockton, Cal.
Tuolumne Prospector, Tuolumne, Cal.
Ventura Daily Post, Ventura, Cal.
Weekly Trinity Journal, Weaverville, Cal.
Western Sentinel, Etna Mills, Cal.



PRODUCERS AND CONSUMERS.

The producer and consumer of mineral products are mutually dependent upon each other for their prosperity, and one of the most direct aids rendered by the Bureau to the mining industry in the past has been that of bringing producers and consumers into direct touch with each other.

This work has been carried on largely by correspondence, supplemented by personal consultation. Lists of buyers of all the commercial minerals produced in California have been made available to producers upon request, and likewise the owners of undeveloped deposits of various minerals, and producers of them, have been made known to those looking for raw mineral products.

When the publication of MINING IN CALIFORNIA was on a monthly basis, current inquiries from buyers and sellers were summarized and lists of mineral products or deposits 'wanted' or 'for sale' included in each issue.

It is important that inquiries of this nature reach the mining public as soon as possible and in order to avoid the delay incident to the present quarterly publication of MINING IN CALIFORNIA, these lists are now issued monthly in the form of a mimeographed sheet under the title of 'Commercial Mineral Notes.'



EMPLOYMENT SERVICE.

Following the establishment of the Mining Division branch offices in 1919, a free technical employment service was offered as a mutual aid to mine operators and technical men for the general benefit of the mineral industry.

Briefly summarized, men desiring positions are registered, the cards containing an outline of the applicant's qualifications, position wanted, salary desired, etc., and as notices of 'positions open' are received, the names and addresses of all applicants deemed qualified are sent to the prospective employer for direct negotiations.

Telephone and telegraphic communications are also given immediate attention.

The Bureau registers technical men, or those qualified for supervisory positions, and vacancies of like nature, only, as no attempt will be made to supply common mine and mill labor.

A list of current applications for positions and 'positions open' is carried in each issue. Notices are designated by a key number, and the name and address corresponding to any number will be supplied upon request, without delay or charge of any kind. If desired, recommendations may be filed with an application, but copies only should be sent to the Bureau, to avoid possible loss. Registration cards for the use of both prospective employers and employees may be obtained at any office of the Bureau upon request, and a cordial invitation is extended to the industry to make free use of the facilities afforded.

POSITIONS WANTED.

- 41-11 Mining or Metallurgy. Three years' experience as surveyor, engineer, and chemist. Age 27. Single. References. Salary open.
- 41-12 Shift boss, foreman or assayer. Twenty-five years' experience in mines and mills of Nevada, Arizona, and California. Age 50. Married. References. Salary open.
- 41-13 Chemist's Assistant. Four years' study I.C.S. in analytical chemistry. Age 45. Married. References. Salary open.
- 41-14 Technical position in oil or gas production. Five years' experience. Age 29. Single. References. Salary wanted \$175.
- 41-15 Industrial engineer; millwright. Ten years' experience as civil engineer, industrial engineer and superintendent of construction. Age 40. Married. References. Salary wanted \$4800.



PUBLICATIONS OF THE CALIFORNIA STATE MINING BUREAU.

During the past forty-four years, in carrying out the provisions of the organic act creating the California State Mining Bureau, there have been published many reports, bulletins and maps which go to make up a library of detailed information on the mineral industry of the state, a large part of which could not be duplicated from any other source.

One feature that has added to the popularity of the publications is that many of them have been distributed without cost to the public, and even the more elaborate ones have been sold at a price which barely covers the cost of printing.

Owing to the fact that funds for the advancing of the work of this department have often been limited, many of the reports and bulletins mentioned were printed in limited editions which are now entirely exhausted.

Copies of such publications are available, however, in the Bureau's offices in the Ferry Building, San Francisco; New Orpheum Building, Los Angeles; Chamber of Commerce Building, Sacramento; Santa Maria; Santa Paula; Coalinga; Taft; Bakersfield. They may also be found in many public, private and technical libraries in California and other states, and foreign countries.

A catalog of all publications of the Bureau, from 1880 to 1917, giving a synopsis of their contents, is issued as Bulletin No. 77.

Publications in stock may be obtained by addressing any of the offices of the State Mining Bureau and enclosing the requisite amount in the case of publications that have a list price. The Bureau is authorized to receive only coin, stamps or money orders, and it will be appreciated if remittance is made in this manner rather than by personal check.

The prices noted include delivery charges to all parts of the United States. Money orders should be made payable to the State Mining Bureau.

REPORTS.

Asterisks (**) indicate the publication is out of print.

	Price
**First Annual Report of the State Mineralogist, 1880, 43 pp. Henry G. Hanks -----	-----
**Second Annual Report of the State Mineralogist, 1882, 514 pp., 4 illustrations, 1 map. Henry G. Hanks-----	-----
**Third Annual Report of the State Mineralogist, 1883, 111 pp., 21 illustrations. Henry G. Hanks-----	-----
**Fourth Annual Report of the State Mineralogist, 1884, 410 pp., 7 illustrations. Henry G. Hanks-----	-----
**Fifth Annual Report of the State Mineralogist, 1885, 234 pp., 15 illustrations, 1 geological map. Henry G. Hanks-----	-----
**Sixth Annual Report of the State Mineralogist, Part I, 1886, 145 pp., 3 illustrations, 1 map. Henry G. Hanks-----	-----
**Part II, 1887, 222 pp., 36 illustrations. William Irelan, Jr.-----	-----
**Seventh Annual Report of the State Mineralogist, 1887, 315 pp. William Irelan, Jr. -----	-----
**Eighth Annual Report of the State Mineralogist, 1888, 948 pp., 122 illustrations. William Irelan, Jr.-----	-----
**Ninth Annual Report of the State Mineralogist, 1889, 352 pp., 57 illustrations, 2 maps. William Irelan, Jr.-----	-----

REPORTS—Continued.

Asterisks (**) indicate the publication is out of print.

	Price
**Tenth Annual Report of the State Mineralogist, 1890, 983 pp., 179 illustrations, 10 maps. William Ireland, Jr.-----	----
Eleventh Report (First Biennial) of the State Mineralogist, for the two years ending September 15, 1892, 612 pp., 73 illustrations, 4 maps. William Ireland, Jr.-----	\$1.00
**Twelfth Report (Second Biennial) of the State Mineralogist, for the two years ending September 15, 1894, 541 pp., 101 illustrations, 5 maps. J. J. Crawford-----	----
**Thirteenth Report (Third Biennial) of the State Mineralogist, for the two years ending September 15, 1896, 726 pp., 93 illustrations, 1 map. J. J. Crawford-----	----
Chapters of the State Mineralogist's Report, Biennial Period, 1913-1914, Fletcher Hamilton:	
**Mines and Mineral Resources, Amador, Calaveras and Tuolumne Counties, 172 pp., paper-----	----
Mines and Mineral Resources, Colusa, Glenn, Lake, Marin, Napa, Solano, Sonoma and Yolo Counties, 208 pp., paper-----	.50
Mines and Mineral Resources, Del Norte, Humboldt, and Mendocino Counties, 59 pp., paper-----	.25
**Mines and Mineral Resources, Fresno, Kern, Kings, Madera, Mariposa, Merced, San Joaquin and Stanislaus Counties, 220 pages, paper-----	----
Mines and Mineral Resources of Imperial and San Diego Counties, 113 pp., paper-----	.35
**Mines and Mineral Resources, Shasta, Siskiyou and Trinity Counties, 180 pp., paper-----	----
Fourteenth Report of the State Mineralogist, for the Biennial Period 1913-1914, Fletcher Hamilton, 1915:	
A General Report on the Mines and Mineral Resources of Amador, Calaveras, Tuolumne, Colusa, Glenn, Lake, Marin, Napa, Solano, Sonoma, Yolo, Del Norte, Humboldt, Mendocino, Fresno, Kern, Kings, Madera, Mariposa, Merced, San Joaquin, Stanislaus, San Diego, Imperial, Shasta, Siskiyou, and Trinity Counties, 974 pp., 275 illustrations, cloth-----	2.00
Chapters of the State Mineralogist's Report, Biennial Period, 1915-1916, Fletcher Hamilton:	
**Mines and Mineral Resources, Alpine, Inyo and Mono Counties, 176 pp., paper-----	----
**Mines and Mineral Resources, Butte, Lassen, Modoc, Sutter, and Tehama Counties, 91 pp., paper-----	----
Mines and Mineral Resources, El Dorado, Placer, Sacramento, and Yuba Counties, 198 pp., paper-----	.65
Mines and Mineral Resources, Monterey, San Benito, San Luis Obispo, Santa Barbara, and Ventura Counties, 183 pp., paper-----	.65
Mines and Mineral Resources, Los Angeles, Orange, and Riverside Counties, 136 pp., paper-----	.50
**Mines and Mineral Resources, San Bernardino and Tulare Counties, 186 pp., paper-----	----
**Fifteenth Report of the State Mineralogist, for the Biennial Period 1915-1916, Fletcher Hamilton, 1917:	
A General Report on the Mines and Mineral Resources of Alpine, Inyo, Mono, Butte, Lassen, Modoc, Sutter, Tehama, Placer, Sacramento, Yuba, Los Angeles, Orange, Riverside, San Benito, San Luis Obispo, Santa Barbara, Ventura, San Bernardino and Tulare Counties, 990 pp., 413 illustrations, cloth-----	----
Chapters of the State Mineralogist's Report, Biennial Period 1917-1918, Fletcher Hamilton:	
Mines and Mineral Resources of Nevada County, 270 pp., paper-----	.75
Mines and Mineral Resources of Plumas County, 188 pp., paper-----	.50
Mines and Mineral Resources of Sierra County, 144 pp., paper-----	.50
Seventeenth Report of the State Mineralogist, 1920, Mining in California during 1920, Fletcher Hamilton; 562 pp., 71 illustrations, cloth-----	1.75

REPORTS—Continued.

Asterisks (**) indicate the publication is out of print.

	Price
Eighteenth Report of the State Mineralogist, 1922, Mining in California, Fletcher Hamilton. Chapters published monthly beginning with January, 1922:	
**January, **February, March, April, May, June, July, August, September, October, November, December, 1922-----	Free
Chapters of Nineteenth Report of the State Mineralogist, 'Mining in California,' Fletcher Hamilton and Lloyd L. Root. January, February, March, September, 1923 -----	Free
Chapters of Twentieth Report of the State Mineralogist, 'Mining in California,' Lloyd L. Root. Published quarterly. January, April, July, October, 1924, per copy-----	\$0.25
Chapters of Twenty-first Report of the State Mineralogist, 'Mining in California,' Lloyd L. Root. Published quarterly.	
January, 1925, Mines and Mineral Resources of Sacramento, Monterey and Orange counties-----	.25
April, 1925, Mines and Mineral Resources of Calaveras, Merced, San Joaquin, Stanislaus and Ventura counties-----	.25
July, 1925, Mines and Mineral Resources of Del Norte, Humboldt and San Diego counties -----	.25
October, 1925, Mines and Mineral Resources of Siskiyou, San Luis Obispo and Santa Barbara counties-----	.25
Subscription, \$1.00 in advance (by calendar year, only).	
Chapters of Twenty-second Report of the State Mineralogist, 'Mining in California,' Lloyd L. Root. Published quarterly.	
January, 1926, Mines and Mineral Resources of Trinity and Santa Cruz counties -----	.25
April, 1926, Mines and Mineral Resources of Shasta, San Benito and Imperial counties -----	.25
Chapters of State Oil and Gas Supervisor's Report:	
Summary of Operations—California Oil Fields, July, 1918, to March, 1919 (one volume) -----	Free
Summary of Operations—California Oil Fields. Published monthly, beginning April, 1919:	
**April, **May, June, **July, **August, **September, **October, November, **December, 1919 -----	Free
January, February, March, April, **May, June, July, **August, September, October, November, December, 1920-----	Free
January, **February, **March, **April, May, June, **July, August, **September, **October, **November, **December, 1921-----	Free
January, February, March, April, May, June, July, August, September, October, November, December, 1922-----	Free
January, February, March, April, May, June, July, August, September, October, November, December, 1923-----	Free
January, February, March, April, May, June, July, August, September, October, November, December, 1924-----	Free
January, February, March, April, May, June, July, August, September, October, November, December, 1925-----	Free
January, February, March, April, May, June, 1926-----	Free

BULLETINS.

Asterisks (**) indicate the publication is out of print.

**Bulletin No. 1. A Description of Some Desiccated Human Remains, by Winslow Anderson. 1888, 41 pp., 6 illustrations-----	----
**Bulletin No. 2. Methods of Mine Timbering, by W. H. Storms. 1894, 58 pp., 75 illustrations-----	----
**Bulletin No. 3. Gas and Petroleum Yielding Formations of Central Valley of California, by W. L. Watts. 1894, 100 pp., 13 illustrations, 4 maps-----	----
**Bulletin No. 4. Catalogue of Californian Fossils, by J. G. Cooper, 1894, 73 pp., 67 illustrations. (Part I was published in the Seventh Annual Report of the State Mineralogist, 1887.)-----	----

BULLETINS—Continued.

Asterisks (**) indicate the publication is out of print.

	Price
**Bulletin No. 5. The Cyanide Process, 1894, by Dr. A. Scheidel. 140 pp., 46 illustrations-----	-----
Bulletin No. 6. California Gold Mill Practices, 1895, by E. B. Preston, 85 pp., 46 illustrations-----	\$0.50
**Bulletin No. 7. Mineral Production of California, by Counties for the year 1894, by Charles G. Yale. Tabulated sheet-----	-----
**Bulletin No. 8. Mineral Production of California, by Counties for the year 1895, by Charles G. Yale. Tabulated sheet-----	-----
**Bulletin No. 9. Mine Drainage, Pumps, etc., by Hans C. Behr. 1896, 210 pp., 206 illustrations-----	-----
**Bulletin No. 10. A bibliography Relating to the Geology, Palæontology and Mineral Resources of California, by Anthony W. Vogdes. 1896, 121 pp.-----	-----
**Bulletin No. 11. Oil and Gas Yielding Formations of Los Angeles, Ventura and Santa Barbara counties, by W. L. Watts. 1897, 94 pp., 6 maps, 31 illustrations-----	-----
**Bulletin No. 12. Mineral Production of California, by Counties for 1896, by Charles G. Yale. Tabulated sheet-----	-----
**Bulletin No. 13. Mineral Production of California, by Counties for 1897, by Charles G. Yale. Tabulated sheet-----	-----
**Bulletin No. 14. Mineral Production of California, by Counties for 1898, by Charles G. Yale-----	-----
**Bulletin No. 15. Map of Oil City Fields, Fresno County, by John H. Means. 1899-----	-----
**Bulletin No. 16. The Genesis of Petroleum and Asphaltum in California, by A. S. Cooper. 1899, 39 pp., 29 illustrations-----	-----
**Bulletin No. 17. Mineral Production of California, by Counties for 1899, by Charles G. Yale. Tabulated sheet-----	-----
**Bulletin No. 18. Mother Lode Region of California, by W. H. Storms. 1900, 154 pp., 49 illustrations-----	-----
**Bulletin No. 19. Oil and Gas Yielding Formations of California, by W. L. Watts. 1900, 236 pp., 60 illustrations, 8 maps-----	-----
**Bulletin No. 20. Synopsis of General Report of State Mining Bureau, by W. L. Watts. 1901, 21 pp. This bulletin contains a brief statement of the progress of the mineral industry in California for the four years ending December, 1899-----	-----
**Bulletin No. 21. Mineral Production of California by Counties, by Charles G. Yale. 1900. Tabulated sheet-----	-----
**Bulletin No. 22. Mineral Production of California for Fourteen Years, by Charles G. Yale. 1900. Tabulated sheet-----	-----
Bulletin No. 23. The Copper Resources of California, by P. C. DuBois, F. M. Anderson, J. H. Tibbitts and G. A. Tweedy. 1902, 282 pp., 69 illustrations, and 9 maps-----	.50
**Bulletin No. 24. The Saline Deposits of California, by G. E. Bailey. 1902, 216 pp., 99 illustrations, 5 maps-----	-----
**Bulletin No. 25. Mineral Production of California, by Counties, for 1901, by Charles G. Yale. Tabulated sheet-----	-----
**Bulletin No. 26. Mineral Production of California for the past Fifteen Years, by Charles G. Yale. 1902. Tabulated sheet-----	-----
**Bulletin No. 27. The Quicksilver Resources of California, by William Forstner. 1903, 273 pp., 144 illustrations, 8 maps-----	-----
**Bulletin No. 28. Mineral Production of California, for 1902, by Charles G. Yale. Tabulated sheet-----	-----
**Bulletin No. 29. Mineral Production of California for Sixteen Years, by Charles G. Yale. 1903. Tabulated sheet-----	-----
**Bulletin No. 30. Bibliography Relating to the Geology, Palæontology, and Mineral Resources of California, by A. W. Vogdes. 1903, 290 pp.-----	-----
**Bulletin No. 31. Chemical Analyses of California Petroleum, by H. N. Cooper. 1904. Tabulated sheet-----	-----
**Bulletin No. 32. Production and Use of Petroleum in California, by Paul W. Prutzman. 1904, 230 pp., 116 illustrations, 14 maps-----	-----
**Bulletin No. 33. Mineral Production of California, by Counties, for 1903, by Charles G. Yale. Tabulated sheet-----	-----

BULLETINS—Continued.

Asterisks (**) indicate the publication is out of print.

	Price
**Bulletin No. 34. Mineral Production of California for Seventeen Years, by Charles G. Yale. 1904. Tabulated sheet-----	-----
**Bulletin No. 35. Mines and Minerals of California, by Charles G. Yale. 1904, 55 pp., 20 county maps. Relief map of California-----	-----
**Bulletin No. 36. Gold Dredging in California, by J. E. Doolittle. 1905, 120 pp., 66 illustrations, 3 maps-----	-----
**Bulletin No. 37. Gems, Jewelers' Materials, and Ornamental Stones of California, by George F. Kunz. 1905, 168 pp., 54 illustrations-----	-----
**Bulletin No. 38. Structural and Industrial Materials of California, by Wm. Forstner, T. C. Hopkins, C. Naramore and L. H. Eddy. 1906, 412 pp., 150 illustrations, 1 map-----	-----
**Bulletin No. 39. Mineral Production of California, by Counties, for 1904, by Charles G. Yale. Tabulated sheet-----	-----
**Bulletin No. 40. Mineral Production of California for Eighteen Years, by Charles G. Yale. 1905. Tabulated sheet-----	-----
**Bulletin No. 41. Mines and Minerals of California, for 1904, by Charles G. Yale. 1905, 54 pp., 20 county maps-----	-----
**Bulletin No. 42. Mineral Production of California, by Counties, 1905, by Charles G. Yale. Tabulated sheet-----	-----
**Bulletin No. 43. Mineral Production of California for Nineteen Years, by Charles G. Yale. Tabulated sheet-----	-----
**Bulletin No. 44. California Mines and Minerals for 1905, by Charles G. Yale. 1907, 31 pp., 20 county maps-----	-----
**Bulletin No. 45. Auriferous Black Sands of California, by J. A. Edman. 1907. 10 pp.-----	-----
Bulletin No. 46. General Index of Publications of the California State Mining Bureau, by Charles G. Yale. 1907, 54 pp.-----	\$0.30
**Bulletin No. 47. Mineral Production of California, by Counties, 1906, by Charles G. Yale. Tabulated sheet-----	-----
**Bulletin No. 48. Mineral Production of California for Twenty Years. 1906, by Charles G. Yale-----	-----
**Bulletin No. 49. Mines and Minerals of California for 1906, by Charles G. Yale. 34 pp.-----	-----
Bulletin No. 50. The Copper Resources of California, 1908, by A. Hausmann, J. Kruttschnitt, Jr., W. E. Thorne and J. A. Edman, 366 pp., 74 illustrations. (Revised edition.)-----	1.00
**Bulletin No. 51. Mineral Production of California, by Counties, 1907, by D. H. Walker. Tabulated sheet-----	-----
**Bulletin No. 52. Mineral Production of California for Twenty-one Years, 1907, by D. H. Walker. Tabulated sheet-----	-----
**Bulletin No. 53. Mineral Production of California for 1907, with County Maps, by D. H. Walker, 62 pp.-----	-----
**Bulletin No. 54. Mineral Production of California, by Counties, by D. H. Walker, 1908. Tabulated sheet-----	-----
**Bulletin No. 55. Mineral Production of California for Twenty-two Years, by D. H. Walker, 1908. Tabulated sheet-----	-----
**Bulletin No. 56. Mineral Production for 1908, with County Maps and Mining Laws of California, by D. H. Walker. 78 pp.-----	-----
**Bulletin No. 57. Gold Dredging in California, by W. B. Winston and Chas. Janin. 1910, 312 pp., 239 illustrations and 10 maps-----	-----
**Bulletin No. 58. Mineral Production of California, by Counties, by D. H. Walker, 1909. Tabulated sheet-----	-----
**Bulletin No. 59. Mineral Production of California for Twenty-three Years, by D. H. Walker, 1909. Tabulated sheet-----	-----
**Bulletin No. 60. Mineral Production for 1909, County Maps and Mining Laws of California, by D. H. Walker. 94 pp.-----	-----
**Bulletin No. 61. Mineral Production of California, by Counties for 1910, by D. H. Walker. Tabulated sheet-----	-----
**Bulletin No. 62. Mineral Production of California for Twenty-four Years, by D. H. Walker, 1910. Tabulated sheet-----	-----
**Bulletin No. 63. Petroleum in Southern California, by P. W. Prutzman. 1912, 430 pp., 41 illustrations, 6 maps-----	-----

BULLETINS—Continued.

Asterisks (**) indicate the publication is out of print.

	Price
**Bulletin No. 64. Mineral Production for 1911, by E. S. Boalich. 49 pp.---	----
**Bulletin No. 65. Mineral Production for 1912, by E. S. Boalich. 64 pp.---	----
**Bulletin No. 66. Mining Laws of the United States and California. 1914, 89 pp.-----	----
**Bulletin No. 67. Minerals of California, by Arthur S. Eakle. 1914, 226 pp.-----	----
**Bulletin No. 68. Mineral Production for 1913, with County Maps and Mining Laws, by E. S. Boalich. 160 pp.-----	----
**Bulletin No. 69. Petroleum Industry of California, with Folio of Maps (18 by 22), by R. P. McLaughlin and C. A. Waring. 1914, 519 pp., 13 illustrations, 83 figs. [18 plates in accompanying folio.]-----	----
**Bulletin No. 70. Mineral Production for 1914, with County Maps and Mining Laws. 184 pp.-----	----
**Bulletin No. 71. Mineral Production for 1915, with County Maps and Mining Laws, by Walter W. Bradley. 193 pp., 4 illustrations-----	----
Bulletin No. 72. The Geologic Formations of California, by James Perrin Smith. 1916, 47 pp.-----	\$0.25
Reconnaissance Geologic Map (of which, Bulletin 72 is explanatory), in 23 colors. Scale: 1 inch equals 12 miles. Mounted.-----	2.50
**Bulletin No. 73. First Annual Report of the State Oil and Gas Supervisor of California, for the fiscal year 1915-16, by R. P. McLaughlin. 278 pp., 26 illustrations.-----	----
Bulletin No. 74. Mineral Production of California in 1916, with County Maps, by Walter W. Bradley. 179 pp., 12 illustrations-----	Free
**Bulletin No. 75. United States and California Mining Laws, 1917. 115 pp., paper-----	----
Bulletin No. 76. Manganese and Chromium in California, by Walter W. Bradley, Emile Huguenin, C. A. Logan, W. B. Tucker and C. A. Waring, 1918. 248 pp., 51 illustrations, 5 maps, paper-----	.50
Bulletin No. 77. Catalogue of Publications of California State Mining Bureau, 1880-1917, by E. S. Boalich. 44 pp., paper-----	Free
Bulletin No. 78. Quicksilver Resources of California, with a Section on Metallurgy and Ore-Dressing, by Walter W. Bradley, 1918. 389 pp., 77 photographs and 42 plates (colored and line cuts), cloth-----	1.50
Bulletin No. 79. Magnesite in California, by Walter W. Bradley, 1925, 147 pp., 62 photographs, 11 line cuts and maps, cloth-----	1.00
Bulletin No. 80. Tungsten, Molybdenum and Vanadium in California. (In preparation.)-----	----
Bulletin No. 81. Foothill Copper Belt of California. (In preparation.)-----	----
**Bulletin No. 82. Second Annual Report of the State Oil and Gas Supervisor, for the fiscal year 1916-1917, by R. P. McLaughlin, 1918. 412 pp., 31 illustrations, cloth-----	----
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**Bulletin No. 84. Third Annual Report of the State Oil and Gas Supervisor, for the fiscal year 1917-1918, by R. P. McLaughlin, 1918. 617 pp., 28 illustrations, cloth-----	----
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Bulletin No. 86. California Mineral Production for 1918, with County Maps, by Walter W. Bradley, 1919. 212 pp., paper-----	Free
**Bulletin No. 87. Commercial Minerals of California, with notes on their uses, distribution, properties, ores, field tests, and preparation for market, by W. O. Castello, 1920. 124 pp., paper-----	----
Bulletin No. 88. California Mineral Production for 1919, with County Maps, by Walter W. Bradley, 1920. 204 pp., paper-----	Free
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Bulletin No. 91. Minerals of California, by Arthur S. Eakle, 1923, 328 pp., cloth-----	1.00

BULLETINS—Continued.

Asterisks (**) indicate the publication is out of print.

Bulletin No. 92. Gold Placers of California, by Chas. S. Haley, 1923. 167 pp., 36 photographs and 7 plates (colored and line cuts, also geologic map), cloth -----	\$1.50
Extra copies of the Geologic Map (in 4 colors) -----	.50
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Bulletin No. 96. California Mineral Production for 1924, by Walter W. Bradley, 1925. 173 pp., paper -----	Free

PRELIMINARY REPORTS.

Asterisks (**) indicate the publication is out of print.

	Price
**Preliminary Report No. 1. Notes on Damage by Water in California Oil Fields, December, 1913. By R. P. McLaughlin. 4 pp. -----	----
**Preliminary Report No. 2. Notes on Damage by Water in California Oil Fields, March, 1914. By R. P. McLaughlin. 4 pp. -----	----
Preliminary Report No. 3. Manganese and Chromium, 1917. By E. S. Boalich. 32 pp. -----	Free
Preliminary Report No. 4. Tungsten, Molybdenum and Vanadium. By E. S. Boalich and W. O. Castello, 1918. 34 pp. Paper -----	Free
Preliminary Report No. 5. Antimony, Graphite, Nickel, Potash, Strontium and Tin. By E. S. Boalich and W. O. Castello, 1918. 44 pp. Paper. -----	Free
**Preliminary Report No. 6. A Review of Mining in California During 1919. Fletcher Hamilton, 1920. 43 pp. Paper -----	----
**Preliminary Report No. 7. The Clay Industry in California. By E. S. Boalich, W. O. Castello, E. Huguenin, C. A. Logan, and W. B. Tucker, 1920. 102 pp. 24 illustrations. Paper -----	----
**Preliminary Report No. 8. A Review of Mining in California During 1921, with Notes on the Outlook for 1922. Fletcher Hamilton, 1922. 68 pp. Paper -----	----

MISCELLANEOUS PUBLICATIONS.

Asterisks (**) indicate the publication is out of print.

**First Annual Catalogue of the State Museum of California, being the collection made by the State Mining Bureau during the year ending April 16, 1881. 350 pp. -----	----
**Catalogue of books, maps, lithographs, photographs, etc., in the library of the State Mining Bureau at San Francisco, May 15, 1884. 19 pp. -----	----
**Catalogue of the State Museum of California, Volume II, being the collection made by the State Mining Bureau from April 16, 1881, to May 5, 1884. 220 pp. -----	----
**Catalogue of the State Museum of California, Volume III, being the collection made by the State Mining Bureau from May 15, 1884, to March 31, 1887. 195 pp. -----	----
**Catalogue of the State Museum of California, Volume IV, being the collection made by the State Mining Bureau from March 30, 1887, to August 20, 1890. 261 pp. -----	----
**Catalogue of the Library of the California State Mining Bureau, September 1, 1892. 149 pp. -----	----
**Catalogue of West North American and Many Foreign Shells with Their Geographical Ranges, by J. G. Cooper. Printed for the State Mining Bureau, April, 1894. -----	----
**Report of the Board of Trustees for the four years ending September, 1900. 15 pp. Paper -----	----
Bulletin. Reconnaissance of the Colorado Desert Mining District. By Stephen Bowers, 1901. 19 pp. 2 illustrations. Paper -----	Free
Commercial Mineral Notes. A monthly mimeographed sheet, beginning April, 1923 -----	Free

MAPS.

Registers of Mines With Maps.

Asterisks (**) indicate out of print.

	Price
**Register of Mines, with Map, Amador County -----	----
**Register of Mines, with Map, Butte County -----	----
**Register of Mines, with Map, Calaveras County -----	----
**Register of Mines, with Map, El Dorado County -----	----
**Register of Mines, with Map, Inyo County -----	----
**Register of Mines, with Map, Kern County -----	----
**Register of Mines, with Map, Lake County -----	----
**Register of Mines, with Map, Mariposa County -----	----
**Register of Mines, with Map, Nevada County -----	----
**Register of Mines, with Map, Placer County -----	----
**Register of Mines, with Map, Plumas County -----	----
**Register of Mines, with Map, San Bernardino County -----	----
**Register of Mines, with Map, San Diego County -----	----
Register of Mines, with Map, Santa Barbara County -----	\$0.25
**Register of Mines, with Map, Shasta County -----	----
**Register of Mines, with Map, Sierra County -----	----
**Register of Mines, with Map, Siskiyou County -----	----
**Register of Mines, with Map, Trinity County -----	----
**Register of Mines, with Map, Tuolumne County -----	----
Register of Mines, with Map, Yuba County -----	.25
Register of Oil Wells, with Map, Los Angeles City -----	.35

OTHER MAPS.

Asterisks (**) indicate the publication is out of print.

**Map of California, Showing Mineral Deposits (50 x 60 in.)—	
Map of Forest Reserves in California—	
Mounted -----	.50
**Unmounted -----	----
**Mineral and Relief Map of California -----	----
**Map of El Dorado County, Showing Boundaries, National Forests -----	----
**Map of Madera County, Showing Boundaries, National Forests -----	----
**Map of Placer County, Showing Boundaries, National Forests -----	----
**Map of Shasta County, Showing Boundaries, National Forests -----	----
**Map of Sierra County, Showing Boundaries, National Forests -----	----
**Map of Siskiyou County, Showing Boundaries, National Forests -----	----
**Map of Tuolumne County, Showing Boundaries, National Forests -----	----
**Map of Mother Lode Region -----	----
**Map of Desert Region of Southern California -----	----
Map of Minaret District, Madera County -----	.20
Map of Copper Deposits in California -----	.05
**Map of Calaveras County -----	----
**Map of Plumas County -----	----
**Map of Trinity County -----	----
**Map of Tuolumne County -----	----
Geological Map of Inyo County. Scale 1 inch equals 4 miles. -----	.60
Map of California accompanying Bulletin No. 89, showing generalized classification of land with regard to oil possibilities. Map only, without Bulletin -----	.25
Geological Map of California, 1916. Scale 1 inch equals 12 miles. As accurate and up-to-date as available data will permit as regards topography and geography. Shows railroads, highways, post offices and other towns. First geological map that has been available since 1892, and shows geology of entire state as no other map does. Geological details lithographed in 23 colors. Mounted -----	2.50
Topographic Map of Sierra Nevada Gold Belt, showing distribution of auriferous gravels. In 4 colors -----	.50

OIL FIELD MAPS.

Price

These maps are revised from time to time as development work advances and ownerships change.

Map No. 1—Sargent, Santa Clara County-----	\$0.50
Map No. 2—Santa Maria, including Cat Canyon and Los Alamos-----	.75
Map No. 3—Santa Maria, including Casmalia and Lompoc-----	.75
Map No. 4—Whittier-Fullerton, including Olinda, Brea Canyon, Puente Hills, East Coyote and Richfield-----	.75
Map No. 5—Whittier-Fullerton, including Whittier, West Coyote, and Montebello-----	.75
Map No. 6—Salt Lake, Los Angeles County-----	.75
Map No. 7—Sunset and San Emido and Kern County-----	.75
Map No. 8—South Midway and Buena Vista Hills, Kern County-----	.75
Map No. 9—North Midway and McKittrick, Kern County-----	.75
Map No. 10—Belridge and McKittrick, Kern County-----	.75
Map No. 11—Lost Hills and North Belridge, Kern County-----	.75
Map No. 12—Devils Den, Kern County-----	.75
Map No. 13—Kern River, Kern County-----	.75
Map No. 14—Coalinga, Fresno County-----	1.00
Map No. 15—Elk Hills, Kern County-----	.75
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Map No. 17—Santa Paula-Sespe Oil Fields, Ventura County-----	.75
Map No. 18—Piru-Simi-Newhall Oil Fields-----	.75
Map No. 19—Arroyo Grande, San Luis Obispo County-----	.75
Map No. 20—Long Beach Oil Field-----	1.00
Map No. 21—Portion of District 4, Showing Boundaries of Oil Fields, Kern and Kings counties-----	.75
Map No. 22—Portion of District 3, Showing Oil Fields, Santa Barbara County-----	.75
Map No. 23—Portion of District 2, Showing Boundaries of Oil Fields, Ventura County-----	.75
Map No. 24—Portion of District 1, Showing Boundaries of Oil Fields, Los Angeles and Orange counties-----	.75
Map No. 26—Huntington Beach Oil Field-----	.75
Map No. 27—Santa Fe Springs Oil Field-----	.75
Map No. 28—Torrance, Los Angeles County-----	.75
Map No. 29—Dominguez, Los Angeles County-----	1.00
Map No. 30—Rosecrans, Los Angeles County-----	.75
Map No. 31—Inglewood, Los Angeles County-----	.75

DETERMINATION OF MINERAL SAMPLES.

Samples (limited to three at one time) of any mineral found in the state may be sent to the Bureau for identification, and the same will be classified free of charge. No samples will be determined if received from points outside the state. It must be understood that no assays, or quantitative determinations will be made. Samples should be in lump form if possible, and marked plainly with name of sender on outside of package, etc. No samples will be received unless delivery charges are prepaid. A letter should accompany sample, giving locality where mineral was found and the nature of the information desired.

THE STATE MINING BUREAU
CORDIALLY INVITES YOU TO VISIT
ITS VARIOUS DEPARTMENTS MAINTAINED
FOR THE PURPOSE OF FURTHERING
THE DEVELOPMENT OF THE
MINERAL RESOURCES OF CALI-
FORNIA

At the service of the public are the scientific reference library and reading room, the general information bureau, the laboratory for the free determination of mineral samples found in the state, and the largest museum of mineral specimens on the Pacific Coast. The time and attention of the state mineralogist, as well as that of his technical staff, are also at your disposal.

Office hours: 9 a.m. to 5 p.m. daily
Saturday, 9 a.m. to 12 m.

Lloyd L. Root,
State Mineralogist.

Third floor, Ferry Building, San Francisco, Cal.
Branch Offices: New Orpheum Building, Los Angeles; Chamber of Commerce Building (mail address, P. O. Box 1208), Sacramento; Bank of Italy Building, Bakersfield; Taft, Coalinga, Santa Maria, and Santa Paula.

Mining in California



OCTOBER, 1926.

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CALIFORNIA STATE MINING BUREAU

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NOTE.—A detailed report of the activities of the Department of Petroleum and Gas is issued monthly by the State Mining Bureau, entitled 'Summary of Operations, California Oil Fields.'

CALIFORNIA STATE MINING BUREAU

FERRY BUILDING, SAN FRANCISCO

LLOYD L. ROOT

State Mineralogist

Vol. 22

OCTOBER, 1926

No. 4

CHAPTER OF

REPORT XXII OF THE STATE
MINERALOGIST

COVERING

MINING IN CALIFORNIA

AND THE

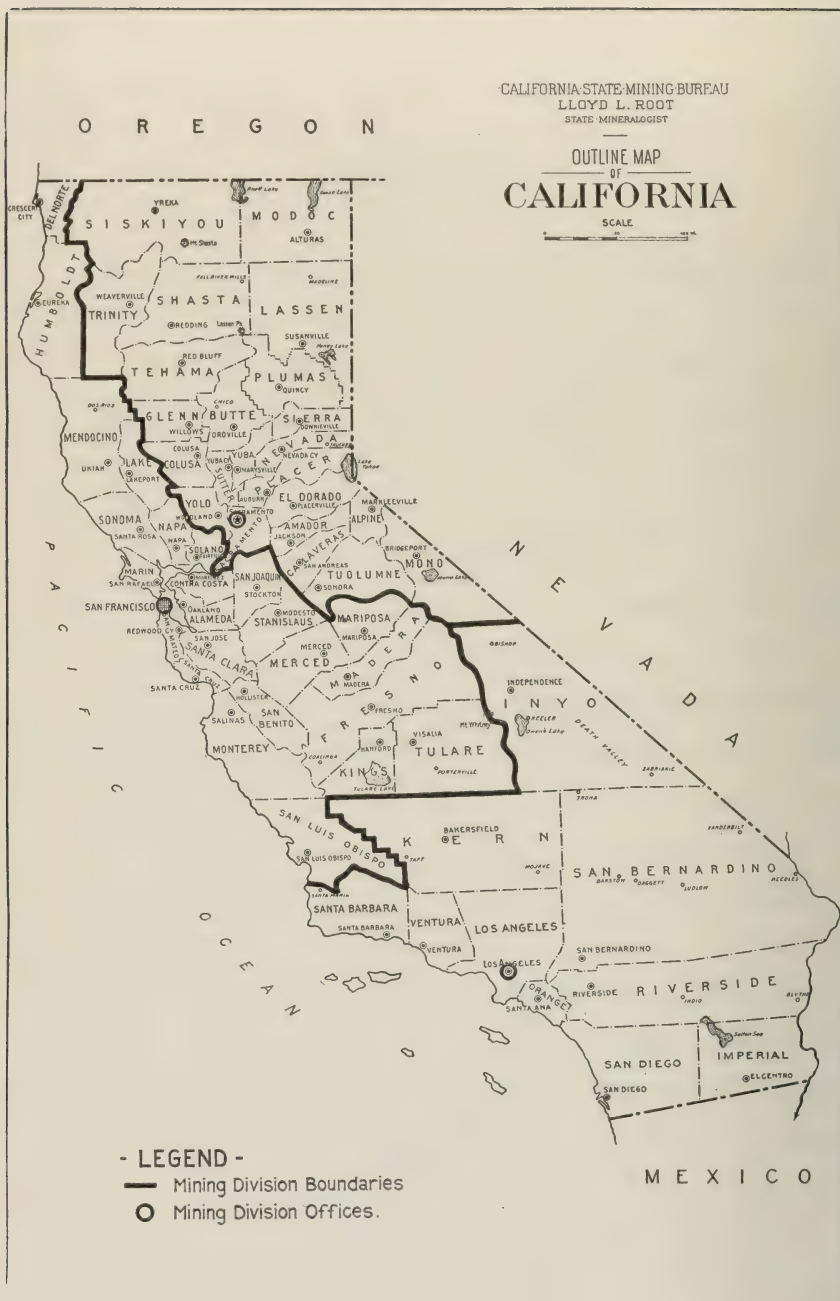
ACTIVITIES OF THE STATE MINING BUREAU



CALIFORNIA STATE PRINTING OFFICE
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SACRAMENTO, 1927

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PREFACE.

The State Mining Bureau is maintained for the purpose of assisting in all possible ways in the development of California's mineral resources.

As one means of offering tangible service to the mining public, the State Mineralogist for many years has issued an annual or a biennial report reviewing in detail the mines and mineral deposits of the various counties.

The weak point in work of this character has been that the results of field investigations were so long in preparation that they had lost much of their usefulness by the time they finally appeared in print.

As a progressive step in advancing the interests of the mineral industry, publication of the Annual Report of the State Mineralogist in the form of monthly chapters was begun in January, 1922, and continued until March, 1923.

Owing to a lack of funds for printing, quarterly publication was begun in September, 1923.

For the same reason, beginning with the January, 1924, issue, it has been necessary to charge a subscription price of \$1 per calendar year, payable in advance; single copies, 25 cents apiece. 'Mining in California' will continue to be sent without charge to our exchange list, including schools and public libraries, as are also other publications of the State Mining Bureau.

Pages are numbered consecutively throughout the year and an index to the complete reports is included annually in the closing number.

Such a publication admits of several improvements over the old method of procedure. Each issue contains a report of the current development and mining activities of the state, prepared by the district mining engineers. Special articles dealing with various phases of mining and allied subjects by members of the staff and other contributors are included. Mineral production reports formerly issued only as an annual statistical bulletin are published herein as soon as returns from producers are compiled. The executive activities, and those of the laboratory, museum, library, employment service and other features with which the public has had too little acquaintance also are reported.

While current activities of all descriptions will be covered in these chapters, the Bureau will not discontinue its practice of issuing from time to time technical reports on special subjects. A list of such reports now available is appended hereto, and the names of new bulletins will be added in the future as they are completed.

The chapters will be subject to revision, correction and improvement. Constructive suggestions from the mining public will be gladly received, and are invited.

The one aim of the Mining Bureau is to increase its usefulness and to stimulate the intelligent development of the wonderful, latent resources of the State of California.

DISTRICT REPORTS OF MINING ENGINEERS.

In 1919-1920 the Mining Department was organized into four main geographical divisions, with the field work delegated to a mining engineer in each district working out from field offices that were established in Redding, Auburn, San Francisco and Los Angeles, respectively.

This move brought the Bureau into closer personal contact with operators, and it has many advantages over former methods of conducting field work.

To continue this system most effectively with the limited funds available, the Redding and Auburn field offices were consolidated and moved to Sacramento on June 1, 1923.

The boundaries of each district were adjusted and the counties now included in each of the three divisions, and the locations of the branch offices, are shown on the accompanying outline map of the state. (Frontispiece.)

Reports of mining activities and development in each division, prepared by the district engineer, will continue to appear under the proper field division heading.

Although the petroleum industry is but little affiliated with other branches of mining, oil and gas are among the most valuable mineral products of California, and a report by the State Oil and Gas Supervisor on the current development and general conditions in the state's oil fields is included under this heading.

New County Reports.

The series of separate reports on the mines and mineral resources of the different counties, that together comprise the State Mineralogist's Reports XIV to XVII, inclusive, in the case of many of the counties have become exhausted. Those still in stock are in need of revision. It was deemed advisable, therefore, beginning with the January, 1925, issue of 'Mining in California,' to make the district engineers' reports in the form of a complete general report on the mines and mineral resources in one or more of the counties in each district.

This program will be followed as near as possible in succeeding numbers of the quarterly until each county in the state has been covered.

SACRAMENTO FIELD DIVISION.

C. A. LOGAN, Mining Engineer.

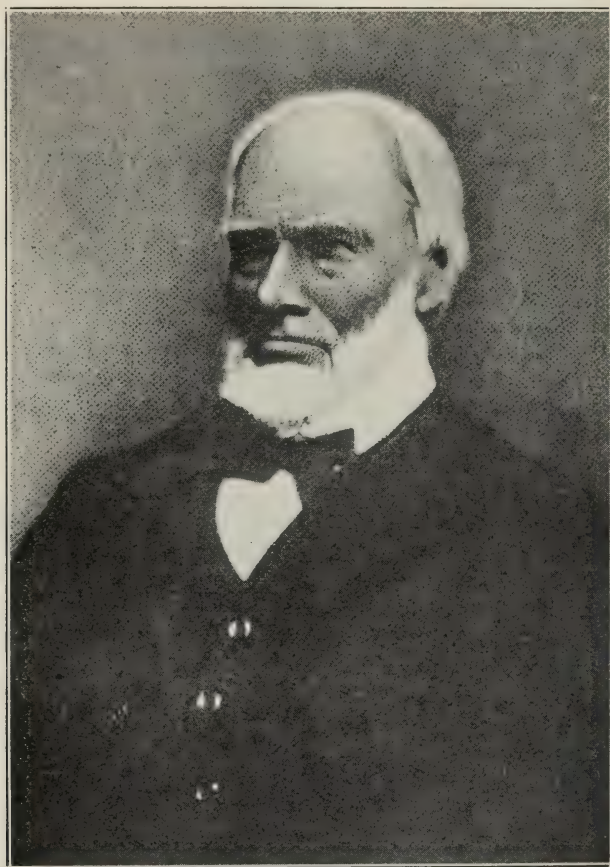
EL DORADO COUNTY.

Geography.

This county was the scene of Marshall's gold discovery in January, 1848, and was the Mecca of the pioneers who spread within two years thereafter over all the mining regions of eastern and northern California. In climate, scenery and resources, El Dorado shares the characteristics of Placer County on the north and Amador on the south. The western border reaches nearly to the Sacramento Valley, and many of the peaks which form the line between El Dorado and Alpine on the east and southeast reach an elevation of 10,000 feet. Lake

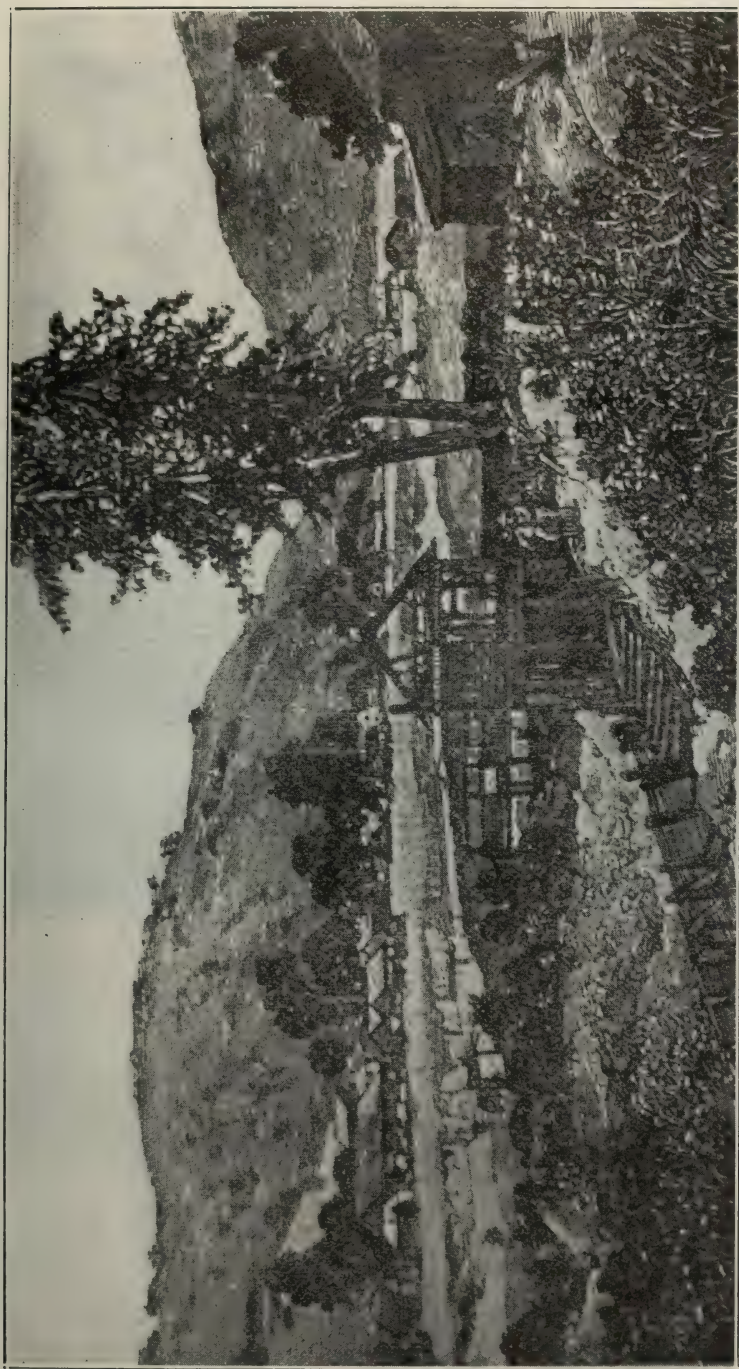
Tahoe, at an elevation of 6225 feet, and having a depth of nearly 2000 feet, lies partly in eastern El Dorado County, which is noted as a summer resort region. The county had a population of 6426 in 1920 and has an area of 1753 square miles. Most of the population is in the western part, below an elevation of 2500 feet.

The Placerville branch of the Southern Pacific Company runs from Sacramento to Placerville, a distance of 59 miles, and the state highway traverses the entire county from White Rock to Lake Tahoe, passing through Shingle Springs, El Dorado, Placerville and Camino, and



James W. Marshall, discoverer of gold at Coloma.

thence following the course of the South Fork of American River to its headwaters, crossing the summit at an elevation of 7630 feet and dropping into Lake Valley at the southern end of Lake Tahoe. From Placerville good roads run in all directions to the various mining regions. To the north are Kelsey, Coloma, Greenwood and Georgetown, from seven to 18 miles distant. From El Dorado the road runs 14 miles south to Plymouth, most of the distance close to the Mother Lode. Georgetown and the northwestern part of the county have auto stage connection with the Southern Pacific at Auburn, 20 miles west of



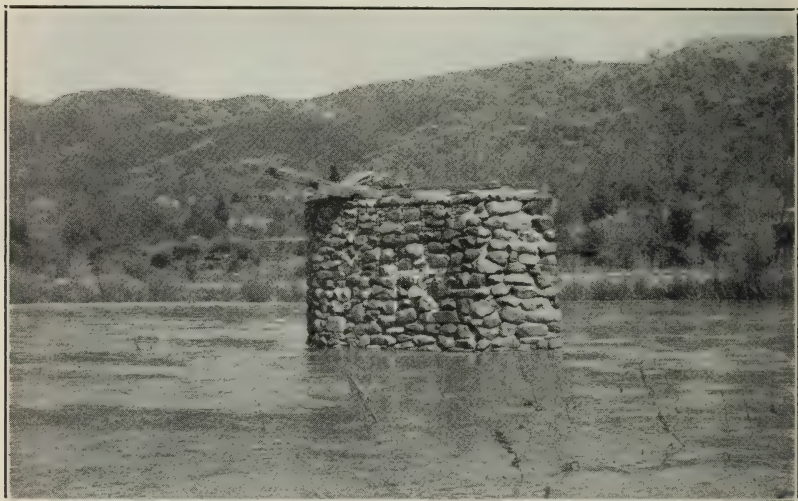
Sutter's Mill at Coloma, where Marshall discovered gold January 24, 1848. As it appeared in 1851.

Georgetown. The proposed Mother Lode Highway would run from Plymouth past El Dorado, Placerville, Kelsey, Cool and Auburn and is in fair condition to travel the year around.

Lumbering and cattle-raising are the principal industries of the higher western slope, east of Placerville. The land around Placerville, Coloma and Cool is devoted mostly to fruit raising. Most of the mines are on the Mother Lode or west of it, and below 3000 feet in elevation, below which contour snow seldom falls in quantity sufficient to lie on the ground more than a few days at a time.

Mineral Resources.

Famous originally as a gold mining region, from which association it was aptly named, El Dorado has also large developed deposits of limestone, slate, soapstone, chromite, and quartz and less known resources of copper, iron, asbestos and other minerals. Samples of



The site of Sutter's Mill as it appears today.

mica, molybdenite, zircon, graphite, ocher and volcanic ash come from deposits that have so far been unprospected and which lie for the most part in the higher and rougher regions. Roscoelite, a rare vanadium-mica found at very few other places, was found during the early mining days at the Stuckslager mine near Coloma. Platinum-group metals occur in small quantity in the gold placers, especially in American River. Rock crystal (clear crystallized quartz) and diamonds have been found.

The earliest gold production was from the present streams which had eroded the ancient channels and gold quartz veins and often had very rich gold-bearing gravel in their beds and bars. Quartz mining, hydraulicking and drift mining soon followed. Placer gold production fell off with the cessation of hydraulic mining, as those who followed this line of work were forced to submit to anti-debris legislation. Gold production from quartz mines continued to be important up to the time of the World War, when increased costs made operation of many properties unprofitable, as their ores were low or medium-grade.

Limestone has in the past few years become the most important single item of mineral production in the county. It is used mostly in the manufacture of cement, outside of the county, although smaller quantities find a market for many purposes.

Roofing slate heretofore produced in California came principally from this county and there is hope at present that the slate making industry will be revived.

Power and Water.

Both forks of the American River are utilized for generating electricity, and much of the water of Cosumnes River has also been appropriated. There is at this time believed to be little unappropriated water remaining in these streams, which drain the entire county. Electricity is available for mining use or could be brought to properties not now supplied, at reasonable cost along the Mother Lode. Sufficient water for milling is also to be had in all the mining districts. The utility companies and the districts served are: Western States Gas and Electric Company, Placerville and districts east and west of there; Truckee River General Electric Company, Georgetown district; Pacific Gas & Electric Company, the western part of the county from the Mountain Quarries near Cool to points south of Rattlesnake bridge. A new project, contemplating the erection of a high dam on the North Fork of American River just above Folsom Prison, would affect water rights on that fork and would back the water up in an immense lake extending upstream beyond Rattlesnake bridge.

EL DORADO

Year	Gold, value	Silver, value	Copper		Lime	
			Pounds	Value	Barrels	Value
1880	\$389,383	\$208				
1881	550,000	900				
1882	600,000					
1883	530,000					
1884	575,000	16,000				
1885	35,000					
1886	619,992	1,822				
1887	706,871	365				
1888	650,000	500				
1889	427,638	408				
1890	204,583	275				
1891	173,279	359				
1892	198,321					
1893	294,610	1,220				
1894	366,707	356			10,000	\$8,000
1895	700,101	448			28,500	28,500
1896	812,289	534			4,413	4,158
1897	674,626	886			13,500	6,750
1898	501,966	4,174			3,360	3,360
1899	404,497	8,414			7,935	7,935
1900	368,541	25,129	3,125	\$500	7,500	6,000
1901	292,036	5,977			11,000	11,000
1902	335,031	52	2,128	319	24,599	16,176
1903	277,304				5,600	7,000
1904	474,994				12,864	7,075
1905	384,735	2,525	160,000	24,960	9,260	6,946
1906	431,746	2,690			19,217	21,138
1907	319,177	2,301		122		16,198
1908	342,033	5,504	603	83	15,921	20,192
1909	238,284	1,299			13,828	14,591
1910	171,304	967			11,300	9,944
1911	133,967	1,010			15,086	12,309
1912	105,565	843			14,023	11,218
1913	62,688	250	693	107		
1914	133,886	654			14,000	12,082
1915	401,288	1,353	417	73	15,911	12,872
1916	361,821	1,496				
1917	24,758	85	18,982	5,182		
1918	28,352	722	22,259	5,498		
1919	30,121	279				
1920	13,379	155				
1921	34,109	301				
1922	47,340	376				
1923	30,264	185				
1924	28,207	153				
1925	40,212	238				
Totals	\$14,526,015	\$91,621	*208,207	\$36,844	*257,817	\$243,444

¹ In addition to the segregated figures herein given, a large tonnage of limestone is annually shipped from El Dorado County for use in cement manufacture, and whose value is included in the state total for cement.

² Includes crushed rock, rubble, rip-rap, sand, gravel.

³ See under 'Unapportioned.'

SACRAMENTO FIELD DIVISION.

403

COUNTY, 1880-1925.

[illegible]

ASBESTOS.

A total production of 142 tons of asbestos was reported in this county between 1904 and 1906, but there is no record of any later operations.

Contraband Claims. Owner, Woodside-Eureka Mining Company, care R. B. Myers, 204 Bacon Block, Oakland. The claims are in Sec. 24, T. 12 N., R. 10 E., and produced some asbestos as mentioned, years ago.

Bibl: Cal. State Min. Bur. Bull. 38, p. 262.

French Hill Mine, six miles north of Greenwood is a gold mine in the seam diggings belt, showing asbestos prospects.

Serpentine areas, in which chrysotile asbestos might occur, extend north and south for six miles in the region two miles east of Georgetown. The rock is also found in a line of disconnected outcrops extending from Cosumnes River northwest past Latrobe, thence east of Clarkville and west of Salmon Falls to the North Fork of American River, and another series of lenses begin close to the first group on Cosumnes River and run nearly north through Shingle Springs, Green Valley, and west of Garden Valley.

CHROMITE.

El Dorado County was one of the larger producers of chromite during the World War but the mines have been shut down since the price collapsed. Numerous concentrating plants for treating low-grade ore were put up and were in use in the district between Folsom and Rattlesnake bridge on the North Fork of American River, when the crash came. The mill of Placer Chrome Company near Rattlesnake bridge continued intermittent operation until the end of 1920, but has been idle since.

The chromite mining operations in the county were fully described in our Bulletin 76, 'Manganese and Chromium in California,' pages 131-144. Many small lenses of high-grade ore were worked out previous to November, 1918, but larger bodies of lower grade which will yield a high-grade concentrate remain in the vicinity of the old Zantgraf quartz mine, and from there southward to the South Fork of American River, the principal owners of land in the chromite belt being P. C. Drescher of Sacramento, Central Pacific Railway, A. L. Dobbas, Auburn, Mrs. Jane Darrington, Folsom, and the Burnett, Pilliken and other ranches. Chromite was also shipped from a number of properties in the serpentine areas of the southeastern part of the county, east, northwest and north of Latrobe station. The above districts were the nearest to the railroad, Newcastle and Folsom having been the principal shipping points for the mines first mentioned and Latrobe for those farther south. Ore was also hauled from the Coloma, Georgetown and other remote districts.

Principal Chromite Properties in El Dorado County.

Name	Owner's name and address	Location Sec., Twp. and Range
Brandon	G. and M. Brandon, Latrobe	8 - 8- 9
Burnett		Near Darrington Ranch
Cowell	H. Cowell L. & C. Co., San Francisco	Near Clarksville
C. P. Ry.	Central Pacific Ry., Land Dept., San Francisco	Various
Chaix	Sixtie Chaix, Latrobe	12, 14- 8- 9
Darrington	Mrs. Jane Darrington, Folsom	29 -11- 8
Dobbas	Arthur Dobbas, Auburn	16, 22-11- 8
Drescher	P. C. Drescher, Sacramento	17, 20-11- 8
		21 -11- 8
Evanis	John C. Evanis, Clarksville	Near Clarksville
Forni	J. C. Forni, Latrobe	4 miles west of Latrobe
Glenn	P. E. and M. Glenn, Latrobe	2 miles SE. of Latrobe.
Green	W. C. Green, Georgetown	19 -13-11
Hoff	Peter Hoff et al., Latrobe	30 - 8-10
Irish Ranch		7, 8- 9-10
Joerger	Ella M. Joerger, 5808 Ocean View Drive, Oakland	35 -10- 8
McCurdy	Mr. McCurdy, Garden Valley	8 -11-10
Murphy	P. B. and Mrs. T. P. Murphy, Latrobe	14 - 8- 9
Ogle	E. C. and W. H. Ogle, Volcanoville	18 -13-11
Pilliken	Geo. Pilliken et al., Folsom	28 -11- 8
Pfeiffer	Wm. Pfeiffer, Latrobe	13 - 8- 9
Pilot Hill	J. Revoir and F. Costa, Pilot Hill	6 -11- 9
Placer Chrome	Leased from C. P. Ry., Drescher et al.	15, 16-11- 8
		21, 22-11- 8
Shelley	L. M. Shelley, Bryte Bldg., Sacramento	5 -11-10
Simpson Ranch		13 -10- 8
Stifle	W. L. Stifle, Georgetown	23 -12-10
Tropper Ranch	Frank Tropper, Greenwood	32 -12-10
Wiley Ranch	D. E. Wiley, Folsom	1, 10-10- 9
		11 -10- 9
Zanini	Zanini Brothers, Latrobe	35 -9- 9

COPPER.

The copper mines of the county were first discovered and prospected between 1861 and 1870, during the initial copper boom in this state. There has been only a small production of copper, the larger part of it having been sold in 1905, when 160,000 pounds was marketed. In 1917 and 1918 ore containing about 40,000 pounds was mined and shipped. There is no record of the output between 1860 and 1870, although some small mines are known to have been productive along the west belt. The development work generally has been only on a very small scale, so that most of the properties should be called prospects, which in late years have been almost totally neglected, due to the low price of copper.

The most westerly group of copper prospects occurs in a north and south belt near the Sacramento and Placer County lines, in the lower foothills. Starting near Latrobe and Cothrin, and extending to the vicinity of Cool, copper ores, sometimes with gold, silver and zinc, can be found at frequent intervals. Most of these deposits are either sulphide impregnations or replacements of the amphibolite schist country rock, or quartz veins carrying sulphides. East of the Mother Lode, copper ore occurs in places near the contact of granodiorite and limestone and other rocks of the Calaveras formation, as at the Cosumnes Copper Mine in the canyon of the Middle Fork of Cosumnes River, five miles southwest of Grizzly Flat. It is also found in this association around the periphery of granodiorite areas west of the Mother Lode, as

southwest of Mt. Ararat. Prospects have been noticed in or near the serpentine east of Georgetown.

As long as copper remains at its present low price, there is little incentive for developing small copper mines. The prospects in the southwestern part of the county are near the railroad and accordingly could ship ore at a lower cost than the others. During 1917 and 1918 work began on several properties. The following summarizes copper mining development in the past eight years:

Big Buzzard Mine. Owners, Mrs. Jane Darrington and George Darrington et al., Folsom. It is in the SE $\frac{1}{4}$ of Sec. 29, T. 11 N., R. 8 E., about eight miles north of Folsom. The mineral portion of property covers 2500 feet on the strike. The vein dips east and strikes north to northwest.

An inclined shaft on the vein has been sunk 267 feet, with levels at 70, 160 and 260 feet. On the 70-foot level, a drift was run north on a curving course for 80 feet and a stope about 45 feet long, 35 feet high and 5 feet thick was worked. On this level south, a drift has been run 40 feet and a thickness of 8 to 10 feet was stoped to a height of 25 feet and a length of 20 feet. The ore from the south stope is said to have returned about \$14 a ton in gold, without saving the concentrate, and a little sorted ore from this stope showed satisfactory amounts of silver, copper and lead also. The results from the north stope as reported by the owners showed about one-half as much gold as on the south. On the 160-foot level north, 40 feet from the shaft and within 10 feet of the face, a dike a foot wide cuts across the vein, and from what can be seen, may mark the north boundary of the shoot. On the south on this level the drift is in 36 feet and shows the heavy complex sulphide ore the width of the drift. Similar ore occurs in the shaft from here to the sump. The oreshoot appears to be pitching south and to be principally south of the shaft, but there has not been sufficient drifting in this direction to show the extent of ore. The hanging wall on the 260-foot level is broken and heavy, white mica-schist; and the footwall is smoothly polished, hard amphibolite-schist. There is only 15 feet of drifting on the 260-foot level, in a northerly direction, and the heavy ore is in evidence here on the south side of shaft. Besides the crushing of the hanging wall, there has been some post-mineral movement on the foot-wall and within the vein about two feet from the footwall.

The mine shows several kinds of ore, with pyrite, chalcopyrite, galena and zinblende. The heavy complex ore carries a good deal of zinblende, and the values are reported to be capriciously distributed, so far as assays show.* What system of treatment will be finally adopted to mill the ores of the mine has not been determined, but flotation may solve the problem. There is a 5-stamp mill which has not given good results. The hoist is operated by a 19-h.p. gas engine. A perpetual water supply could be pumped from the river, one-half mile distant and 400 feet lower. Electric power is about 6 miles distant.

* Since the above was written, the shaft is reported to have been sunk to a depth of 300 feet, and a short drift run north. A cross-cut from this drift is said by the operators to have cut a wide vein of complex sulphide ore, carrying 17% zinc sulphide, 2.65% copper and a very satisfactory gold content. George Peltier, Farmers & Mechanics Bank, Sacramento, and A. E. Vandercook, 621 California Street, Sacramento are interested in developing the property. Ten men are employed.

Breala Copper Prospect, a mile west of Breala near Brandon on the Placerville railroad branch, was reopened in 1917 by Victor Bonnefoy. A level about 70 feet deep in the old shaft was cleaned out and some ore said to carry $4\frac{1}{2}\%$ copper, \$2.50 gold and \$1.10 silver was taken out.

Camel Back Mine (Voss Mine). Owner, J. D. Voss, Elk Grove. It contains 680 acres, patented, mostly in Sec. 11, T. 11 N., R. 8 E., 11 miles by road from Auburn on Burner Hill. The last work was done in 1920 by Gold and Copper Holdings Company, but after a short time it reverted to the owner and is idle.

A massive quartz vein striking N. 32° E. and dipping 65° to 80° west, can be traced at intervals for 3500 feet on the slope leading to the river. The vein has a maximum width of 28 feet at the surface, but has not been exposed its full width in the tunnel. The vein has been prospected by two tunnels 65 feet apart vertically, the lower tunnel being about 300 feet below the highest point of outcrop. There is also a shaft 25 feet deep on this vein. No. 2 (upper) tunnel is a drift on the vein 123 feet and No. 3 tunnel is a crosscut for 165 feet then 67 feet on the vein, so that none of the workings have gotten entirely beyond the zone of surface oxidation and leaching. The quartz at the face of workings is of a peculiarly sugary texture carrying considerable chalcopyrite and pyrite, with some bornite, and shows indications of downward leaching. The vein here is so promising as to warrant further drifting southward toward the higher part of the hill, where depth sufficient to get below the leached zone might be attained on these levels.

The owner has the record of a great many assays which he states came from this vein and which indicate an average sufficiently rich in copper, gold and silver to make a good milling ore. To date, however, not enough has been done to give any hint of the possible amount of ore available. The sulphides have been completely leached out of the outcrop. So-called dikes crossing the vein appear to be pyritized zones in the amphibolite and may have influenced mineralization of the vein.

On the east slope of the hill, about one-half mile due east of the above, there is a parallel vein of quartz as much as 18 feet wide in places, which has been opened by a 200-foot shaft, now caved, and a shaft 40 feet deep connected with a crosscut to the vein. Farther south are several short tunnels in bad shape showing possible ore on the dumps, the best of which was outside a caved tunnel about which nothing could be learned. There is no machinery or equipment on the property, and only one small dwelling.

Cothrin Prospect is on the Cothrin Ranch, one-half miles from Cothrin on the Placerville branch of the Southern Pacific Company. Mrs. Ella Cothrin, owner.

An old shaft is said to be about 100 feet deep. The ore is heavy pyrite with a little chalcopyrite, and occurs in amphibolite schist. Two men have done a little work recently preparatory to prospecting the property, and there is a small gas engine and some equipment and tools there.

Larkin Copper Mine near Diamond Springs was reopened in 1918 by Fred Husler and Charles Wachter, under lease and option, and

some ore taken out. It had been opened years before to a depth of 160 feet, with a cross-cut 45 feet long and 100 feet of drifting on the vein.

Little Emma patented claim contains 20 acres in Sec. 3, T. 11 N., R. 9 E., and is owned by W. F. Detert, 995 Market street, San Francisco. In 1917 and 1918 some work was done and a little ore shipped. This is one of the prospects near the granodiorite contact with the Calaveras formation, the ore being in lenses in limestone.

Rip and Tear Mine is about two miles north of Latrobe on the W. H. Dodson ranch. It was worked in the early days and made a small production probably, of which there is no record. In 1918 the old shaft, about 90 feet deep, was reopened and two carloads of good grade copper ore were shipped to a smelter, after which operations ceased and the mine has been idle since. The ore was taken principally out of the shaft, where it had been left by the early operators on one wall. It lies in the amphibolite schist near serpentine, and carries some gold and silver and a large amount of pyrite in addition to chalcopyrite.

Seven Bells Prospect is on the Charles Worthington ranch, about four miles west of Placerville. It was prospected a little in 1917 by the Christiana Copper Company and the same promoter, Frank C. Fox, in 1919 resumed under the name of the *Sporting Boy Mine*, but little was accomplished by either company. A shaft was sunk about 65 feet on a vein from a few inches to 18 inches wide, which was said to carry copper and gold.

The following table gives the location of copper prospects and references to reports on those which have been idle the past ten years:

Table of Copper Prospects in El Dorado County.

Name	Section	Location Twp.	Range	Latest report
Agara -----	19	8 N.	9 E.	Bull. 50, p. 216
Alabaster Cave -----	10, 15	11 N.	8 E.	Bull. 50, p. 211; XV, p. 276
Arizona -----	24	12 N.	10 E.	Bull. 50, p. 214
Big Buzzard -----	29	11 N.	8 E.	R. XIX, p. 141; herein
Bob -----	13	12 N.	10 E.	Bull. 50, p. 219
Boston -----	22	9 N.	9 E.	Bull. 50, p. 216
Breala -----	2	8 N.	9 E.	Herein
Bunker Hill -----	14	12 N.	9 E.	Bull. 50, p. 219
Cambrian -----	23	11 N.	9 E.	Bull. 50, p. 213
Camel Back -----	11	11 N.	8 E.	R. XVII, p. 430
Contraband -----	24	12 N.	10 E.	Bull. 50, p. 214
Copper Chief -----	12	12 N.	10 E.	Bull. 50, p. 216
Costa Ranch -----	12	11 N.	8 E.	Bull. 50, p. 218
Cothrin -----	29	9 N.	9 E.	Herein
Cosumnes -----	24, 25	9 N.	12 E.	Bull. 50, p. 218
Dr. Wren -----	7	9 N.	11 E.	Bull. 50, p. 216
E. E. -----	18	9 N.	11 E.	R. XV, p. 277
Hale -----	25	9 N.	12 E.	R. XV, p. 217
Ireland -----	15	10 N.	10 E.	R. XV, p. 218
Larkin -----	29	10 N.	11 E.	R. XV, p. 277
Little Emma -----	3	11 N.	9 E.	Herein; also Bull. 50, p. 212
Noonday -----	18	9 N.	11 E.	R. XV, p. 278
Pioneer -----	3	11 N.	9 E.	Bull. 50, p. 213
Revoir -----	12	9 N.	12 E.	Bull. 50, p. 217
Rip and Tear -----	3	8 N.	9 E.	Herein
Robert -----	13	9 N.	11 E.	Bull. 50, p. 216
Seven Bells or Sporting Boy -----	4 miles west of Placerville			Herein
Voss -----	See Camel Back			

GEMS.

Emerald beryl has been reported found near Georgetown, but the stones are mostly too small to cut as gems. A reexamination of the material indicates that it is a transparent, green pyroxene rather than beryl.

W. L. Stifle, Georgetown, has claims on Traverse Creek, three miles southeast of Georgetown in an area of serpentine. During the past few years he has reported finding a number of small 'emeralds'. He works through shallow tunnels and has found most of the stones within ten feet of the surface. He also has found some *californite*.

Bibl: Cal. State Min. Bur. Bull. 91, p. 169.

Diamonds have been found in some of the old placer mines on Webber Creek, in White Rock Canyon and at Smiths Flat. The larger ones mentioned were between one and two carats. As there has been little placer mining lately, no recent finds of diamonds have been reported.

Bibl: State Mineralogist's Report IV, pp. 168-170; Bull. 37, pp. 43, 44; Bull. 91, p. 8.

Rock-crystal has been produced from the Snow property, in White Rock Canyon. (See under Silica.)

Bibl: Cal. State Min. Bur. Bull. 37, p. 65.

GOLD (QUARTZ MINES).

Following the policy adopted for our new series of county reports, the writer has prepared as a part of the report on this county a complete table of gold quartz mines so far as shown in our past reports or in the real estate tax roll of the county. This table shows the locations, owners' names and addresses (as shown in county tax records), acreage, and reference to number and page of our past publications dealing with the different properties. Reference to this table will tell at a glance what has been published and where to look for it. In addition, a great deal of information has been gathered by the writer in preparation for a report on the mines on the Mother Lode, including those in this county, but these notes are too extensive to include in a publication of the nature of the quarterly reports and it is hoped they may be published later. The present notes on individual properties are intended to illustrate the general characteristics of certain types of deposits in different districts, as found in actual past mining operations so that the reader may have an idea of what may be expected of other properties coming under the same types. There is also brief mention of the few small operations carried on in recent years, to complete the record since our last report.

Gold production in El Dorado County (in later years principally from quartz mines) dropped abruptly from a total of \$361,821 in 1916 to \$24,758 in 1917, since when the largest recorded output was \$47,340

in 1922. In 1925, a total of 38 producers reported a total production of \$40,450 which includes gold from placer mines, and was probably made up largely from the yield of pocket mines. The recorded gold yield of the county since 1880, which marks rather closely the end of extensive placer mining, has been \$14,907,480 to the close of 1925. This is by no means a measure of the total gold quartz output, as the richest mines such as the Union, with an output of over \$5,000,000, the Pacific, the mines at Nashville and many others had yielded the readily accessible high-grade ores in their upper levels previous to 1880, so that the total gold quartz production has probably been close to \$30,000,000. The later operations which were suspended in 1916 were at mines which produced generally low-grade ores, and which could not operate at the high costs ruling since that date.

The Mother Lode.

The Mariposa slate and accompanying formations of the Mother Lode traverse the entire length of El Dorado County, entering at the confluence of the North and Middle Forks of Cosumnes River two miles south of Nashville, running nearly north seven miles, then turning northeast to Placerville, and thence resuming the normal course north of northwest, passing through Kelsey and Garden Valley. Near the last named place a large body of amphibolite schist in the form of irregular lenses, separates the black slate into two belts, the easterly one of which passes through Georgetown and Georgia Slide, and the westerly through Greenwood and Spanish Dry Diggings. The slate is flanked on the west by altered diabase and amphibolite schist except in the region from the Church Mine to Placerville where different facies of granodiorite form an embayment on that side. On the east, it is bordered principally by the Calaveras (Carboniferous), consisting of slaty and micaceous schists, and quartzite.

Most of the development along the lode in this county has been within the black slate where ore occurs in lenses of solid quartz or 'ribbon rock,' but here as elsewhere the massive quartz veins are generally indicators of the general course of the lode, and do not form the principal orebodies, which occur in some of the other fissures of the lode system, sometimes as branching veins or as a system of stringers rich enough to pay for mining a considerable width. The Georgia Slide mines and others of the so-called 'seam-diggings,' where the gold occurs in a multitude of narrow and discontinuous stringers, are a type met in the northern part of the county, although such mines as the Taylor and St. Lawrence had the usual quartz orebodies.

The greatest depths reached on the Mother Lode in El Dorado County are 2000 feet at the Pacific, 1640 feet at the Union, 1400 at the Church and 1200 feet or less elsewhere, as compared with over 4000 feet at the deeper mines in Amador County. Mining has been practically suspended along the Mother Lode in El Dorado County during the past ten years, the county having suffered more than any other from increased cost of operation and diversion of capital to other fields. The ores as a rule are easily treated, the gold being readily recoverable by straight stamp-milling, battery and plate amalgamation. Pyrite and a much smaller amount of galena form about 2% of the ore and carry up to \$100 a ton in gold.

Past production and geologic conditions at several places along the lode in this county would seem to justify deep development by well financed companies, in the hope that ore may again be found in the deeper levels, as the upper system of orebodies paid well.

Mentioning in order from south to north the principal past mining operations along the Mother Lode, we come first to those at Nashville. The Nashville or Havilah mine was worked to a depth of 1200 feet in the black Mariposa slate on a quartz and stringer lead 5 to 20 feet thick with heavy gouge in places. The first operations in the district were by Mexicans and Chilians, the quartz outcrops near Nashville having supported numerous arrastres before stamp mills were built. Operations at the Havilah were intermittent and the total output was estimated at \$1,500,000. Later, in 1906, the 1200 level of the Havilah was run north under the Montezuma and beyond it, and the latter mine was also prospected to a depth of 1000 feet by Bewick, Moreing and Company of London in 1913 and 1914, but this work was suspended when the war began, and nothing has been done since. Two miles east of Nashville, the Inez, Baldwin and Last Chance mines lie idle. Recently only one small mine, the Bonanza, near the county line has produced in this district.

Between Nashville and El Dorado two small operations, the Red Wing and the Martinez mines each with five-stamp mills, employ two to four men each and run the mills at intervals. In this region lie the Union and Church mines, the former at one time the principal gold quartz producer of the county but idle for many years after making a production of nearly \$6,000,000 to a depth of 1640 feet. Numerous other past producers with shafts from 250 to 1000 feet deep, lie in this section within the Mariposa slate, but all are now idle. Occasionally some of the many pocket claims on both sides of the Mother Lode make a small production, giving employment to only one or two men each. At Placerville the Pacific Mine, once a producer, is again active. North of that town, the recent reopening of the Poverty Point or Guilford Mine resulted in disappointment. From the South Fork of American River to the northerly county line on the Middle Fork, the only recent activity has been at the Hines Gilbert, Sliger and Cedarberg mines near Spanish Dry Diggings and some small crushing of ore near Garden Valley. The Hines Gilbert employs a few men and has made a small production. In the region of Coloma, Kelsey, Greenwood, Georgetown and Spanish Dry Diggings, are a great many pocket and seam mines, several of which employ one or two men each during the winter season. Just north of Coloma stands Mt. Murphy, where the Last Chance mine yielded the largest gold pocket ever found in the county, containing about \$250,000. In recent years no very large pockets have been found. Most of the mineral land in the vicinity of these old camps has been held for years as patented or unpatented mining claims, as homesteads or railroad lands, with little or no mining being done by the owners. There is not much incentive for the average prospector to enter such a district, although there may be indications to attract him, as he knows he may be told to move at any time and can seldom be sure he is not on land claimed by others, even where signs of mining activity or human occupancy are lacking.

Other Districts.

Both east and west of the Mother Lode in the granodiorite and schists, valuable mines have been worked. The two best examples of mines in the granodiorite are the Mt. Pleasant near Grizzly Flat and the Zantgraf mine near the west county line. The ores of the granodiorite are more complex in depth, and the veins narrower and richer, than those on the Mother Lode.

Another type of deposit, where rocks of igneous origin carry disseminated auriferous pyrite sufficient to make ore, are represented by the Oro Fino and Shaw mines.

Big Buzzard Mine is one of the few that have been active recently. It is an interesting example of a complex ore, containing pyrite, chalcopyrite, galena, zincblende, gold and silver. It occurs in the amphibolite schist close to the granodiorite contact, eight miles north of Folsom and one-half mile east of American River. The hanging wall of the vein is white mica schist and the footwall hard amphibolite schist. The shaft has been sunk 267 feet and three levels have been drifted short distances, with small stopes five to ten feet wide. Some ore milled in the 5-stamp mill yielded \$5 to \$14 a ton in gold without saving sulphides, but the ore is capriciously distributed. No successful system of treatment has been applied yet to recover the various metals.

Big Canyon (Oro Fino) Mine contained an orebody formed by the mineralization of a mass of diabase breccia, which was silicified and impregnated with auriferous pyrite, this forming 3% to 10% of the ore, and carrying 70% of the gold, the balance being fine free gold which was amalgamated on the plates. It has a serpentine hanging wall, but is said to blend into the footwall schist in such a way as to indicate that it is a replacement deposit. The orebody was stoped for a depth of 500 feet, length of 400 feet and thickness of 20 to 30 feet, but in places more.

Brust Mine (formerly *Asbestos* or *Gold Hill Mine*) is a mile northeast of American Flat and reached by road from Poors store, north of Kelsey. C. N. Brust is prospecting the claims.

The country rock in which pay has been found is serpentine, which forms a nearly round plug or chimney in the surrounding schist. Free gold occurs around the periphery in stringers of calcite, quartz or talc and in plates in the serpentine. Shallow shafts from 22 to 65 feet deep have been sunk. An adit has been run 800 feet which gives a depth of 200 feet below the surface, and in October, 1926, Brust reported very encouraging prospects in this face which is being advanced. There does not appear to be any well-defined vein in the surface workings, but the specimen rock found is well worth following, and might open into a larger kidney, along the contact although no continuous vein can be expected in the serpentine alone.

At the adit there are two gas engines of 10- and 25-h.p., respectively; a 10-inch by 10-inch compressor and some other equipment.

California Consolidated comprises three claims on the south of the Mount Pleasant and claimed to contain extensions of some of the veins

of the latter. The claims cover 4500 feet along the strike of the veins. An adit 468 feet long has been run and is estimated to require 225 feet additional to strike the Mt. Pleasant vein, where it will have about 300 feet of backs. Some ore was mined in shallow workings years ago and hauled to the Morey mill for crushing. This was from the Tapioca vein and paid \$14 a ton. Other samples and mill tests indicate \$6 to \$11 a ton.

Cedarberg Mine, $2\frac{1}{2}$ miles northwest of Greenwood, was found in 1868 and for several years after was noted for the production of foliated gold. This specimen ore was found in a seam two to four inches wide on the hanging wall. The shaft was sunk 318 feet with three levels. It was reopened a few years ago but for only a short time and without success. It is an example of the mines on the westerly section of the Mother Lode.

Church Mine adjoins the Union on the north, on the Mother Lode. The main shaft was in the footwall and was sunk to a vertical depth of 1200 feet, from which level a winze was sunk on the vein to 1400 feet. The crosscut to the vein on the 1200 level was 670 feet long. There was a poor zone between the 350 and 500 levels, where the ore was displaced by gouge, but ore came in at 500 feet and continued good to 1300 feet. It is said that over a period of 23 years between 1885 and 1907 the ore milled gave an excellent profit, but there was a large quantity of lower grade that might have been mixed with it to increase the tonnage and either increase the life of the operation, or decrease cost per ton by permitting operation on a larger scale. The concentrate averaged \$100 a ton but the amount was small, only two or three tons a month, and most of the gold was saved in the battery. The vein averaged six feet wide and the ore shoot was nearly vertical, and about 70 feet long for most of its depth, though reaching a length of 180 feet. The best ore was in the center. Heavy gouge came in at the 1300 level, and below there only a little prospecting was done. The 600 and 1200 levels were run to the south end-line. The stoped ground was in the black slate.

The total production from this ground, which covers 1650 feet along the strike of the Mother Lode, is uncertain as in the fifties the land later worked at depth as the Church and Union mines was the site of a Mexican settlement of 2000 or more people who mined the adjacent sections of Martinez Creek and worked the float quartz and upper portions of the quartz veins in arrastres. The known output of the Church Mine is placed at \$600,000 with a 10-stamp mill. There is no equipment or buildings on the property at present.

Golden Unit. The old *Argonaut* claim near Greenwood on the Mother Lode was in 1922 made the basis of one of the questionable operations which have done much to ruin the reputation of mining and to cause the public to shun participation in legitimate mining ventures.

In order to escape the State Corporation Securities Act, the promoter resorted to the 'unit plan,' which is aptly named, as it usually benefits the promoter only. In this case the option and lease were obtained,

naming a small price to be paid later. The rights thus acquired were divided into 100 interests or units to be sold at \$250 each, the purchasers of which were to be entitled to one one-hundredth interest in the property for each unit bought. The control of the property was in the hands of the promotor until 50 units should have been sold, as no meeting of unit holders was set and no provision was made for safeguarding the funds or directing the spending of same. The owner, however, protected himself and received his purchase price, consisting of cash from the sale of the first 50 units and a gift of 30 units. A small Gibson mill was put up and the few small bars of gold said to have been recovered from crushing 60 tons of rock gathered on the claim were used to stimulate the sale of units.

The claim had been worked years ago. It shows a wide 'bull quartz' vein and the accompanying stringer lead of the Mother Lode. It was pockety and of low average grade. No new work was done, and after numerous units had been sold, the promotor decamped.

The *Grit Gold Mining Company*, based upon the old seam mines at Spanish Dry Diggings, was one of the recent small promotions which came to grief. After finding a small showing of rich specimen ore, the company put up a mill and incurred other expenses that should have been deferred until further prospecting was done. Had this been done, sufficient money might have remained in the treasury to prospect another property. The Grit paid well in the early days, when it was worked by hydraulicking and by pocket mining to a depth of 125 to 150 feet, where fresh hard rock was found.

Guildford Mine, at Poverty Point on the Mother Lode near Placerville was recently reopened by a stock company composed of Placerville people, and high hopes were entertained regarding its possibilities. The mine had previously been developed by adits, of which the lowest, near the river level, had been run about 600 feet. It was expected that additional work on this level would open the orebody worked years ago on the 500-level adit. The lowest level was advanced 685 feet and a 10-stamp mill was erected. It is stated this mill was put in prematurely. The initial run of ore was unexpectedly low grade, and operations were suspended.

Hines-Gilbert Mine in the steep canyon of the Middle Fork of American River north of Spanish Dry Diggings, has continued operating on a small scale intermittently since our 1920 report, in which it was described. Ore is crushed at intervals in the 10-stamp mill which is operated by water power. This property is being developed by Hines-Gilbert Gold Mines Company of Sacramento. It is on the westerly branch of the Mariposa slate in the contact with amphibolite schist.

Lincoln Mine is a seam mine a mile northwest of Georgetown and is being worked by B. F. Magee. It is near the Georgia Slide diggings.

No recent work has been done at the *Lukens Mine*, mentioned in our Nineteenth Report, 1924, at which time work had been started by a group of Auburn men. No new underground work was done. There are two shafts on the property, 60 and 90 feet deep, respectively, 150

feet apart and connected by a drift. The vein is narrow and is separated by a horse of amphibolite schist into hanging and footwall parts. It has yielded some high grade ore in years past.

Martinez Mines (formerly Hillside Group). W. Grant Busick, manager; E. H. Althoff, secretary, El Dorado. The claims are on Martinez Creek $4\frac{1}{2}$ miles by road southeast of El Dorado, and cover 4500 feet along the Mother Lode south of the Union Mine. The mine workings are in the Mariposa slate east of the 'bull quartz' vein.

The present work is through a short adit, winze and drifts reaching a depth of 86 feet below the outcrop on Hillside No. 3 claim. In these workings the Mariposa slate dips west and the pay is found in small stringers, seams and floors which lie nearly flat with a slight dip west. The ore is claimed to give excellent returns, sometimes for four or five feet in thickness. It is hoisted in a small bucket by hand and taken about one-half mile by sled to a small 5-stamp mill beside the creek. It must yield well, as the method of operation is expensive and allows of handling only a small tonnage. There is not sufficient water in summer to permit milling more than a few tons at a run.

Ten years ago an adit was run 900 feet into the lower part of the hill now being mined. It is estimated that 300 feet additional work is needed to put it directly under the new work and this would give about 230 feet vertical depth below the present bottom of the winze (Oct., 1926). There is a compressor and other equipment at this adit.

At a distance of 700 feet south of present work an old adit 600 feet long crosscuts the vein. Between the two, another crosscut 70 feet long is said to show low-grade ore all the way, and is thought to be on the Red Top ledge, a spur running into the main formation, and which has been opened in the recent work.

The 'bull quartz' vein traverses the Martinez claim 300 feet west of the workings mentioned, and strikes north to N. 10° E. Still farther west, on the Climax claim, are extensive but shallow old workings, where the Mexicans mined in early days.

Morey Mine adjoins Mount Pleasant mine on the north and is the only one recently active in the district. It has been worked since early days and perhaps a dozen shafts 60 to 70 feet deep have been sunk on ten different small veins. Bunches of ore of good grade, six inches in average width and 15 feet long, have been extracted. The best ore was sulphide ore worth \$111 a ton. Ore carrying about 5% sulphides comes in at the water level, 60 feet deep. The pay shoots are said to reach only a shallow depth. Ore is hauled a short distance to the owner's mill.

Morning Star, Lucky Boy and two other claims are on the seam belt a mile east of Georgetown. E. F. Porter works alone making only a small production. The claims have been owned by his family for years and are said to have produced \$75,000.

Montezuma Mine at Nashville was prospected by Bewick, Moreing & Company of London between 1914 and 1916. A shaft near the middle of the Montezuma claim was sunk from a depth of 360 feet to

1000 feet, on an incline of 55° , and several hundred feet of drifting was done to prospect the vein, which was of good width, but work is said to have been suspended due to the war, when British capital was withdrawn from mining prospects not able to support themselves. The assay values varied widely on the different levels, the vein ranging from 4 to 33 feet wide, and assaying from less than \$2 up to fair milling grades, between \$5 and \$10 a ton. This vein had previously been prospected by a drift from the adjacent *Havilah* (*Nashville*) 1200 level, where it was reported of good width and value.

Mount Pleasant Mine was the principal producer of the Grizzly Flat district. It is a mile from Grizzly Flat and 27 miles by road from Placerville. The nearest railroad points are four miles west or south-east on the narrow gauge Diamond and Caldor Railroad. The property covers 5156 feet on the lode.

This mine was opened in 1851 and must have had considerable production previous to 1874. Since that year the recorded output was:

From Oct. 20, 1874, to July 26, 1880	6,000 tons paid	\$153,400
(During this period considerable pay in the sulphides was lost.)		
From July, 1881, to Sept. 30, 1887	46,000 tons paid	643,348
From 1897 to 1904	18,000 tons paid	150,000
From 1904 to 1914	5,000 tons paid	100,000
Total	75,000 tons paid	\$1,046,748

Between 1881 and 1887 the ore averaged \$14 a ton and the cost of operation, including development and dead work, was \$10 to \$10.50 a ton, leaving a profit of \$170,603, out of which dividends of \$150,000, equal to the total capital stock, were paid according to James D. Hague.

A series of parallel veins occur in granodiorite near the contact with mica schist, and occupy a zone about 300 feet wide, in which the veins strike N. 15° E. to N. 39° E., a few degrees east of the strike of the zone, and dip vertically. The principal veins, their size, and extent of development upon them are:

Name of vein	Width	Length developed	Depth reached
Earle	1' to 18'	400-800 feet	1000 feet
Mt. Pleasant	6' to 18'	225 feet	260 feet
McKane	1' to 14'	120 feet	500 feet
Charles	6" to 4'	200 feet	240 feet

Practically all the production has been from the Earle vein, of which one-half the width is said to have been ore and the balance filling and 'horses.' Stopping has been to a depth of 850 feet on this vein. Three shafts 300, 600 and 1040 feet deep, respectively, have been sunk, of which the latter is 1220 feet from the north end line of property. Most of the prospecting has been north of this shaft, the north drifts on the ten levels varying from 300 to 1300 feet long. Stopes were run 180 feet north and 100 to 180 feet south of this shaft. The levels yielded 10,000 to 12,000 tons of ore each down to 700 level. The veins pinch and swell, and consist of banded or ribbon quartz with pyrite, galena and zincblende, and with some copper reported in the bottom level. There was considerable loss by sliming in the early operations. The best pay is said to have been within the granodiorite. The value of rock found

by last operators, Mt. Pleasant Consolidated Gold Mining Company, in 1914 and later was evidently low, the vein in a pinch or split, and work appears to have been stopped before the possibilities of the property were exhausted. The varying dimensions of veins at the different levels made a reliable estimate of possibilities difficult. Besides the Earle vein, the Charles vein with an average ore width of $16\frac{1}{2}$ inches, according to Russell L. Dunn, and average value of \$18 a ton, has some promise. In the McKane vein on the 400 level, it is said there were two feet of high-grade ore on each wall with 4 to 10 feet of low-grade filling between. The mine has been idle for 10 years and lately the old surface plant was burned. The mine had a water right and $4\frac{1}{2}$ miles of ditch from a fork of Cosumnes River. The plant formerly used included steam hoisting engines, 40-h.p. compressor, 10 stamps and 4 Frue concentrators.

Oro Fino Mine is a mile south of Garden Valley in a narrow strip of amphibolite schist. A vein four feet wide strikes northwest to north, and when visited early in August, 1926, a shaft had been sunk 80 feet upon it with dip of about 50° . Samuel Collins of Garden Valley, Mrs. Alva Archer of Sacramento and associates have been working the property during the past year and have hauled some ore to the Frog Pond mill of 2 stamps near Garden Valley, where good returns are reported.

The *Bathurst Claims*, on which a small mill and concentrator were placed and some ore crushed a few years ago by Tetrault and associates, adjoin on the west.

Pacific Quartz Mine at and near Placerville is the principal one of a large group of quartz claims covering three miles along the Mother Lode from a mile south of American River to Webber Creek, all belonging to the same company. The workings were described in detail in the Fifteenth Report of the State Mineralogist, 1916, since which time practically nothing has been done on any of the claims until the present year, when the *Pacific* was taken under lease and has been unwatered so far to the 500 level; some activity is also looked for soon at the *Young Harmon*.

The *Pacific* mine was found in 1852 and a 2-stamp mill was built in 1854. From then until 1861 the yield was \$480,000, the mill having been increased to four, 10 and finally to 20 stamps. The production up to 1883 was about \$1,000,000 according to a county history published that year.

The Old Harmon and Eppley claims, now a part of this group, were also opened at an early date. The ore from the first was worked in arrastres and a 15-stamp mill was put up previous to 1867, but apparently crushed little ore. The Eppley produced some high-grade ore.

A number of veins were found, of which the principal producer was the *Pacific* on the west side of the lode. The *Pacific* shaft was sunk 700 feet and the ore was stoped from the 500 level to the surface, there being two oreshoots 400 and 100 feet long. The shaft is in the black slate of the footwall at the 700 level, where a crosscut east 85 feet cut

a talcose orebody 75 feet by 7 feet. The black slate hanging wall was encountered 130 feet farther east in the crosscut. From the 700 level 200 feet north of the shaft a winze was sunk at an angle of 70° for an inclined depth of 1365 feet. This winze entered the footwall slate at 1600 feet and continued in it to the bottom.

The vein was in an ankerite zone and was ribbon rock in places colored by mariposite. This zone was 300 feet wide at the 700 level and 125 feet wide on the 2000 level where cut in drill holes. Pacific vein was thought to have been faulted east and lost between 300 and 400 levels, and the last ore stoped and milled about 1914 was from the talc orebody. In that year extensive diamond drilling was done from the 1700 and 2000 levels, over 8000 feet of drill holes having failed to find ore.

There is a 5-stamp mill and other equipment at the Pacific shaft which is in the town of Placerville.

Sciaroni Mine is on the north side of North Fork of Cosumnes River, near Grizzly Flat. A formation 60 feet wide, said to average \$3 a ton in gold, is quarried and milled in a small steam-power mill of 5 tons daily capacity. A. Sciaroni and three sons are working the claim intermittently at last account.

Sliger Mine near Spanish Dry Diggings has been actively prospected during the past three years by Sliger Gold Mining Company. The original Sliger Mine was found in 1864 and had a 5-stamp mill in the seventies. The patented claim which was mined contained 5 acres, covering 530 feet along the strike of the vein. There is also an unpatented 20-acre claim and a millsite. Ore was stoped and milled to a depth of 200 feet and for 160 feet in length, besides which a short winze was sunk. The present company installed a hoist, engine and skip in 1923 and sank the shaft 130 feet. Work was continued and encouraging prospects found in drifting on the 350 level.

Threlkel Prospect is a little east of the Zantgraf mine and contains narrow quartz veins of good grade in the granodiorite. There was some production years ago from such a flat vein which was worked through a shallow adit by Jake Zantgraf. L. L. Threlkel has installed a 2-stamp mill and has done some work the past two years.

Union (Springfield) Mine was the largest producer of the county, but very little has been published or definitely known about it, due to the secretive policy of former operators. Previous to 1868, a production of \$450,000 was made from 15,000 tons of ore from the main vein and \$150,000 more, principally from the croppings of the Cosumnes vein on the west. Later, under the management of Poundstone, during a period of 17 years, the Poundstone oreshoot is authentically credited with a production of \$5,100,000. It was worked through the main vertical shaft, 1640 feet deep, and was stoped to a depth of 1300 feet. This shoot is said to have been stoped for a maximum length of 640 feet and average width of 70 inches. Other oreshoots were mined, and

there were a number of other shallower shafts and adits, a total of over 21,000 feet of crosscuts and drifts having been run. The Klondyke adit on the vein of the same name, is credited with an output of \$350,000. Besides all this work, a great deal was done in the early days by the Mexicans, so that the total output of the property will probably never be definitely known.

The holdings cover 13,000 feet along the course of the Mother Lode, only a part of which has been developed and mined at any important depth. A poor zone was encountered at a depth of about 1250 feet and had not been bottomed at 1640 feet, but this condition has also been found at numerous other Mother Lode mines which were well enough financed to continue work until good ore came in again and such mines are now and have been for years producing ore as good as that found in the upper ore-shoots.

The old 20-stamp mill is still on the property but would require rebuilding and there is little other equipment of value.

Vandalia Mine has been under lease and option to various companies in the past eight years including the Grit Gold Mining Company, but none of them have done much actual new development. It is idle at present. The ore has been described as occurring in a quartz schist, heavily impregnated with iron sulphide, and in good sized orebodies, which have been oxidized to a depth of about 100 feet. It was worked for many years beginning in 1885. In 1925 some new cyanide equipment was put on, but has not been used.

Victoria Gold Lode Prospect near Rescue has been worked by Grimshaw, Faris and Cornelius during the past few years. Good prospects were found.

Wagner Mine near Lotus was prospected by lessees in 1925 but is not known to have been productive.

Wiltshire Pocket Mine near Nashville is one of the numerous small producers contributing irregularly to the county's gold output. One man works it occasionally.

Wiedebush Mine, near the Volcanoville road about 10 miles north of Georgetown, is under lease to Gus Orelli of Placerville and others and has been a small producer during the past year.

Zantgraf (Montauk Cons.) Mine is eight miles southeast of Newcastle on the east side of American River near Rattlesnake bridge.

The mine was discovered in 1880 by Jacob Zantgraf, on land which had been patented years before by the Central Pacific Railroad Company, as agricultural land, because the veins do not outcrop conspicuously. About 1883 Zantgraf put up the first mill, of five stamps which was operated about seven months each year by water power, and worked the vein through two adits. In 1886 five stamps were added to the mill. The main vein was worked down to the 300 level adit, and was stoped for a length of about 900 feet. During the time it was worked

by Zantgraf & Company the mine produced \$438,000. In 1895, because of family disagreements, lack of money for sinking, and probably also because they thought the mine was nearly worked out, it was sold to Senator Chapman for \$65,000. He renamed it the Montauk Consolidated, sank the shaft to the 800 level, put up a new 20-stamp mill and produced over \$200,000 before January, 1898, when the mine was sold to Montauk Consolidated Mining Company for about \$100,000. The property was then supplied with electric power from its own hydro-electric plant near by on American River and 5 stamps were added to the mill. From May, 1898, to May, 1901, they produced over \$351,000, the shaft meanwhile having been sunk to 1130 feet. The company became involved in lawsuits for damages and were hard pressed by creditors seeking pay for surface equipment and machinery, much of which should not have been bought. During a temporary shutdown in October, 1901, a fire burned the hoist, shops and mill and the mine has been idle since.

The Zantgraf, Montauk and other nearly parallel veins occupy fissures in granodiorite and amphibolite schist and are accompanied by diorite dikes. They strike northwest and dip southwest from 38° to 50° . Near the main shaft the Zantgraf and Montauk veins are 180 feet apart, diverging to the northwest. Most of the mine workings are in the granodiorite and all the production has been from the Zantgraf vein, only small tests lots having been milled from the Montauk and Porterfield veins on this property. On the adjacent land some work has been done and some ore crushed on a vein which appears to be the Montauk. The main vein pinches and swells both vertically and horizontally and the value of ore varies widely, but there was usually from two to six feet of good ore with a gouge up to a foot wide. The ore averaged about \$8 a ton, although considerable specimen ore occurred, and the bullion ranged in value from \$11 to \$14 an ounce. High-grade pyrite and galena formed 1% to $1\frac{1}{2}\%$ of ore from the 600 level downward. The concentrate contained at times as high as \$90 gold and 90 to 100 ounces silver per ton, besides which considerable pay was lost in the slimes, as a slime plant added in 1898 gave slimes assaying 128 ounces silver and 1.3 ounces gold per ton.

The later operations were through an inclined shaft on the Zantgraf vein to a depth of 1130 feet (715 feet vertical). Two oreshoots were developed; above the 300 adit level they were stoped as one for a length of 900 feet. Below that level most of the ore came from the south oreshoot, which pitched away from the shaft and was about 600 feet long to the 10th level. Levels were run every 100 feet to 1100 level, where the ore shoot was entered 309 feet from the shaft and followed for over 300 feet just previous to closing the mine. The assay values on this level varied from \$2 to over \$100 a ton but apparently averaged about \$7 to \$8 a ton. The vein has been explored for a maximum of 1600 feet in length.

Buildings include a large lodging house, boarding house, office and 10 or 12 small cottages. At the main shaft there is a steam hoist, skip, air compressor and small tools.

TABLE OF QUARTZ MINES AND PROSPECTS, EL DORADO COUNTY.

Name of mine	Location			*Owner's name, address	Elevation, feet	Area, acres	Bibliography
	Sec.	Twp.	Range				
Adams Gulch Group.....	24, 25	9 N.	10 E.	Estate of J. C. Heald, Nashville.....	1,200	320	XII, p. 101; XIII, p. 132; XV, p. 279.
Adjuster.....	12	9 N.	10 E.	O. A. Ingraham, El Dorado.....	1,300	30	XV, p. 280.
Adjuster and Hustler.....	12	9 N.	10 E.	R. B. Seward, Diamond Springs.....	1,250	40	XV, p. 279.
Adambra.....	6, 7	11 N.	11 E.	Pearl McKee, Placerville, et al.....	-----	14	X, p. 178.
Alpine.....	15, 16	12 N.	10 E.	Lucero Gold Mining Co., Inc., 530 Wilcox Bldg., Los Angeles.....	2,550	180	VIII, pp. 167-168; XIII, p. 132; XV, p. 280.
Argonaut.....	17	12 N.	10 E.	Gold Unit Mining Co., c/o Ralph E. Fry, R.F.D. 2, box 1736, Sacramento.....	1,900	25	VIII, p. 176; X, p. 176; XII, pp. 101-102; XIII, pp. 132-133; XV, p. 280; XVIII, p. 209; Pre. Rep. 8, p. 29.
Armstrong and Roberts.....	33	9 N.	13 E.	Armstrong Mining Co., Ninth and Broadway, Oakland.....	3,500	30	XII, pp. 101-102; XV, p. 301; XVII pp. 425-426.
Arctic.....	20	9 N.	13 E.	Fred Irwin, Placerville, et al.....	-----	27	-----
Atlantic.....	17	10 N.	11 E.	Estate of John F. Limpinsel, Placerville, et al.....	-----	-----	-----
Atlantic.....	7	11 N.	11 E.	Atlantic Gold and Silver Mining Co., c/o Pearl McKee, Placerville.....	-----	21	-----
Baldwin.....	1, 2	8 N.	10 E.	Estate of E. J. Baldwin, San Francisco.....	1,500	20	XII, p. 102; XIII, p. 133; XV, p. 280.
Balnaceda.....	35	9 N.	10 E.	Estate of J. C. Heald, Nashville.....	1,100	20	XV, p. 280.
Baltic.....	23	10 N.	13 E.	Reeg and Sciarrossi, Placerville.....	4,250	80	XIII, p. 133; XV, p. 280.
Barbara.....	32	11 N.	10 E.	Wm. Veerkamp and Son, Placerville.....	-----	14	-----
Barnes-Eureka.....	28, 33	10 N.	10 E.	Blair and Berry, Placerville.....	1,500	40	XII, pp. 102, 112; XIII, p. 144; XV, p. 281.
Bathurst.....	33	12 N.	10 E.	Bathurst, Folsom.....	-----	-----	-----
Beattie and Parsons.....	34	13 N.	10 E.	Ira Barklage Ackley, Georgetown; Flora Barklage, Hotel Sacramento, Sacramento; Emma B. Schutz, Arbuckle; Beattie Bros., Georgetown.....	2,450	60	XI, p. 203; XII, p. 102; XIII, p. 133; XV, p. 281 (See Georgia Slide also).

Bell and Dorsy:	8	8 N.	13 E.	Hayward, Hobart and Lane Estates Co., 1128 Merchants Exchange Bldg., San Francisco.	332	
Blue Lead	16, 17	8 N.	13 E.	M. P. Bennett, Placerville.	76	
Bidstrup.	3	11 N.	10 E.	W. I. Bidstrup, El Dorado	1,800	XII, pp. 103-104; XIII, p. 133; XV, p. 281.
	11	9 N.	10 E.			
Big Buzzard	29	11 N.	8 E.	Mrs. Jane Darrington, Folsom, George Darrington, Folsom, et al.		XVII, p. 430; XVIII, p. 209; XIX, pp. 141-142.
						XV, p. 281.
Big Chunk.	24	11 N.	10 E.	Margaret E. Smith, Placerville, et al.	2,200	
Big Four.	34	12 N.	10 E.	John Hunley, Kelsey; James O'Brien, Kelsey;		
				Mary E. Rhodes, Placerville.	1,850	
Big Sandy	24	11 N.	10 E.	Big Sandy Mining Co., c/o J. T. Kelly, Kelsey.	2,000	XV, p. 281.
						X, p. 173; XII, p. 104; XIII, p. 134; XV, p. 281.
Black Hawk.	24	11 N.	10 E.	Oscar Reeg, Placerville and Estate of Blair, Placerville.		
					2,000	XV, p. 281.
Blair	9	10 N.	12 E.	Carrie J. Bacon et al., c/o E. S. Page, Bacon Bldg., Oakland.		X, p. 179; XIII, p. 104.
Blue Bank				Murphy Brothers, Shingle Springs.	625	XIII, p. 134; XV, p. 281.
Blue Gouge.	21	10 N.	13 E.	August Sciaroni, Grizzly Flat, et al.	4,000	XIII, p. 135.
Blue Rock	34	13 N.	10 E.	James E. Flynn, Georgetown, Geo. C. Rau, 1017 G Street, Sacramento, et al.		
Bobby Burns	5	10 N.	12 E.	J. and J. Blair Lumber and Land Co.	2,450	XI, p. 203; XII, p. 104; XV, p. 282.
Bonanza				C. E. Padilla.		
Bona Forsa	11	8 N.	10 E.			XVIII, p. 44.
Bonsect				M. E. Gates, Sacramento.	1,000	X, p. 177.
	3	10 N.	9 E.			XII, p. 104; XIII, p. 135; XV, p. 282.
Booster.				Mrs. Simpson.		
Bordt.	7	12 N.	10 E.	W. Bordt, Greenwood.		
Boston.	4	13 N.	11 E.	American Bar Q. Mining Co., 858 Mills Bldg., San Francisco.	1,700	XV, p. 282.
Boston.	18	11 N.	9 E.	John B. Wagner, Pilot Hill.		
Boulder.	33	11 N.	9 E.	Boulder Mining Co., c/o F. W. Williams, 163 Crocker Bldg., San Francisco.		
Bower.	7	12 N.	10 E.	California Water Company.	1,150	XIII, pp. 135-136; XV, p. 282.
Bright Hope.	2	12 N.	10 E.	Lucy L. Shine, 1525 Twentieth Ave., Oakland;	1,650	XI, p. 204; XIII, p. 136; XV, p. 282.
				Mrs. Gibbs and estate of W. H. Hulbert, Georgetown.		
					2,500	X, p. 177; XII, p. 105; XIII, p. 136; XV, p. 282.
Brust.				Charles N. and Frank P. Brust, Kelsey.		XVIII, p. 44.
Calaveras	6	11 N.	11 E.		525	XIII, p. 136 (4 miles east of Lake).

* Ownership given in this table is that shown in county tax records.

TABLE OF QUARTZ MINES AND PROSPECTS, EL DORADO COUNTY—Continued.

Name of mine	Location			* Owner's name, address	Elevation, feet	Area, acres	Bibliography
	Sec.	Twp.	Range				
Calif. Cons.	21, 16	9 N.	13 E.	Wm. Brown, Oleta.	-----	60	XI, p. 201; XII, p. 113; XIII, 145, 159.
Calif. Jack	22	12 N.	10 E.	Mrs. E. M. Potts and A. L. Jeffrey, 527 Citizens Nat'l Bank Bldg., Los Angeles	2,315	40	XIII, p. 136; XV, p. 282.
Cedarburg	1	12 N.	10 E.	J. T. Smith, Greenwood	2,300	20	XII, p. 106; XIII, p. 137; XV, p. 282; M. R. West of the Rocky Mts., 1873, p. 47.
Chaparral	26	11 N.	10 E.	Phillip Stingle, Boston and Margaret Kelly, Kelsey	2,000	20	XV, p. 283.
Cherokee Flat	24	13 N.	9 E.	Charles Davis and J. Federwitz, Greenwood	-----	17	VIII, pp. 182-183; X, p. 173; XII, p. 106.
Chester	18	10 N.	11 E.	-----	1,875	-----	-----
China Hill	16	9 N.	10 E.	China Hill Mining Co., c/o J. B. Lanktree, 400 Broadway, Oakland	1,400	20	XII, p. 106; XIII, p. 137; XV, p. 283.
Church	12	9 N.	10 E.	Seymour Hill, El Dorado	1,180	42	VIII, pp. 191-193; X, p. 171; XII, p. 106; XIII, pp. 137-138; XV, p. 283; XVIII, p. 209; Bull. 18, p. 92.
Cincinnati	36	11 N.	11 E.	-----	1,750	-----	XII, p. 106; XIII, p. 138.
Climax and Independence	14	11 N.	10 E.	Gopher Boulder Mining Co., c/o W. A. Bell, Kelsey	-----	36	-----
Collins and Bacchi	28	12 N.	10 E.	J. G. Hibbs, Wawa, Pa.	2,200	126	XV, p. 283.
Confidence and Globe	16	10 N.	11 E.	Linden Mining Co., Placerville	-----	100	-----
Cooley	17	13 N.	11 E.	Ida Barklage Ackley, Georgetown	-----	53	-----
Cousin Jack	29	9 N.	13 E.	Mrs. M. Jeffrey, Grizzly Flat	2,800	20	XII, p. 107; XIII, p. 138; XV, p. 283.
Cranes Gulch	15	12 N.	10 E.	Charles Jerrett, Georgetown, et al.	-----	80	-----
Crown Point Consolidated	31	10 N.	11 E.	James Richards, Placerville	1,800	20	XII, p. 107; XIII, p. 138; XV, p. 283; XX, p. 8.
Crusader	12	9 N.	10 E.	Seymour Hill, El Dorado	1,280	60	XV, p. 284.
Crystal	32	9 N.	13 E.	L. L. Alexander, Omo Ranch	3,500	80	XII, p. 107; XIII, p. 138; XV, p. 284.
Crystal	18	9 N.	10 E.	Crystal G. M. Co., c/o Hall Taylor, Hall Luhrs and Co., 908 Second St., Sacramento	-----	11	X, p. 178; XII, pp. 107-108; XIII, p. 138; XV, p. 284.

Crystal.....	18	12 N.	9 E.	E. Terry, C. Ashley and C. Schulz, Cool	1,900	20	XIII, p. 138; XV, p. 284.
Daily and Bishop.....	27	9 N.	13 E.	Bishop, Grizzly Flat, et al.	3,475	40	XII, p. 108; XIII, p. 138; XV, p. 284.
Dalmatia.....	13	11 N.	10 E.	William A. Bell, c/o W. F. I. Bell, Kelsey	2,000	102	VIII, p. 177; X, p. 174; XI, pp. 201-202; XII, p. 108; XV, p. 284.
Darling.....	33	12 N.	11 E.	P. G. Gilpin, 45 Crocker Bldg., San Francisco	2,700	20	XI, p. 202; XII, p. 108; XIII, p. 139; XV, p. 284.
Davidson.....	22, 27	10 N.	10 E.	Central El Dorado Gold Mining Co., 2244 California St., San Francisco	1,700	20	XII, p. 108; XIII, p. 139; XV, pp. 284-285.
Doncaster and Cleveland.....	11	11 N.	10 E.	J. J. Jermyn et al., c/o A. W. Craig, 1317 Oak St., San Francisco		7	
Drury.....	1	12 N.	9 E.	Mrs. Maud Drury, 4239 West St., Oakland		41	
Dunlap.....	36	13 N.	9 E.	Boutwell Dunlap, 66 Geary St., San Francisco		160	
Eagle.....	11	12 N.	12 E.	L. J. Kendrick, 3012 Shattuck Ave., Berkeley	3,600	48	VIII, p. 178; XIII, p. 139; XV, p. 285.
Eagle King.....	9	9 N.	13 E.	Mary Witmer, Placerville	4,000	40	VIII, p. 178; XII, pp. 108-109; XIII, p. 139; XV, p. 285.
Eagle King.....	4, 9	9 N.	13 E.	Charles Edner, Placerville	3,275	160	XII, p. 109; XIII, pp. 139-140; XV, p. 285.
Edner.....							
El Dorado and McKinley.....	26	13 N.	9 E.	Kensington Gold Mining Co., c/o Cleveland Forbes, 1209 Merchants Exchange Bldg., San Francisco		36	
Elf.....	33	11 N.	11 E.	Pioneer Hardware Store, Placerville		40	
Elliot.....	31	10 N.	11 E.	Charles E. Hand, Placerville	1,800		XII, p. 109; XIII, p. 140.
Emma.....	21, 28	12 N.	10 E.	Encinal Mining Co., c/o John Mayhan, Bridge-house, California		19	X, p. 176, XIII, p. 140.
Encinal.....	1	8 N.	12 E.	Placerville Gold Mining Company, Placerville, c/o A. Baring Gould		480	
Epley and Mammoth.....	20	10 N.	11 E.			26	VIII, pp. 186-187; X, p. 173; XIII, p. 109 (see also Pacific).
Equator.....		10 N.	11 E.	Garden Valley Mining Co., c/o Haswell Bros., St. Johns Chambers, Chester, England			VIII, p. 190; X, p. 172; XIII, p. 109.
Esperanza.....	28	12 N.	10 E.		2,460	20	X, p. 175; XII, p. 109; XIII, p. 140; XV, p. 285.
Esperanza.....	7	12 N.	10 E.	Paul Ricci, Greenwood, et al.	1,950	20	Field Report.
Estella.....	6	10 N.	11 E.	Sarah E. Balk, 1450 Eighth Ave., San Francisco			
Eureka.....	36	11 N.	10 E.	Placerville Gold Mining Co., Placerville, c/o A. Baring Gould	2,750	10	X, p. 178; XI, p. 203; XII, p. 109; XV, p. 285 (see also Pacific).

* Ownership given in this table is that shown in county tax records.

TABLE OF QUARTZ MINES AND PROSPECTS, EL DORADO COUNTY—Continued.

Name of mine	Location			*Owner's name, address	Eleva- tion, feet	Area, acres	Bibliography
	Sec.	Twp.	Range				
Eureka.....	4	9 N.	13 E.	H. S. Treat, c/o D. C. Treat, Mission Savings Bank, San Francisco.....	10		
Eureka.....	28	10 N.	10 E.	Blair and Berry, Placerville.....	20		
Fairweather and Fairweather Extensions.....	12	12 N.	9 E.	Mrs. Lovenia E. Pease, 1621 Sixteenth St., Sacramento.....	304		
Falls.....	1	9 N.	10 E.	Joseph Drechsler, Diamond Springs.....	16		XV, p. 285.
Faraday.....	20	10 N.	11 E.	Placerville Gold Mining Co., Placerville.....	16		VIII, p. 186; X, p. 173; XII, p. 110 (see also Pacific).
Fisk.....	7	10 N.	11 E.	J. H. Skinner, Placerville.....	17		XIII, p. 140; XV, pp. 285-286.
Florida.....	13	12 N.	9 E.	Marcus Peterson, Suisun.....	20		
Fort Yuma.....	18	12 N.	10 E.	Hale and Baughman, Indian Diggings.....	29		XII, p. 110; XIII, p. 140.
French.....	29, 32	9 N.	10 E.	California Water and Mining Co.....	18		XI, p. 204; XII, p. 110; XIII, p. 141; XV, p. 286.
French Hill.....	13	12 N.	9 E.	A. J. Johnson and E. S. Hadley, Sacramento.....	160		XII, p. 110; XIII, p. 141; XV, p. 286.
Frog Pond and Marigold Cons.	36	13 N.	9 E.		2,000		
Gallagher.....	28	12 N.	10 E.	S. W. Collins and C. K. Norris, Garden Valley.....	2,200		
Garden Valley.....	5	12 N.	10 E.	F. G. Johnson, Napa, et al.....	40		XV, p. 286.
Gardner Cons.....	28	12 N.	10 E.	Garden Valley Gold Mining Co., c/o Haswell Bros., St. Johns Chambers, Love St., Chester, England.....	21		
Garfield and Excelsior.....	6	10 N.	11 E.	Wm. H. Myers, Placerville.....	23		XII, p. 110.
	5, 6	12 N.	10 E.	F. H. Bitty, Greenwood, et al.....	1,900		XV, p. 286.
General Lee, Bosquit, Sunday, Golden Age.....	19	10 N.	10 E.	Red Raven Cons. Mining Co., 206 Mason Opera House, Los Angeles.....	2,000		XII, p. 111; XIII, p. 141; XV, p. 286.
Gentle Annie.....	6	10 N.	11 E.	George M. Clark, Placerville.....	71		
				Ida Barklage Ackley, Georgetown; Flora Barklage, Hotel Sacramento, Sacramento; Emma B. Schutz, Arbuckle; James E. Flynn, Georgetown; Beattie Bros., Georgetown; Geo. C. Rau, 1017 G St., Sacramento.....	178		X, p. 177, XII, p. 111; XIII, pp. 141-143 (see River Hill also).
Georgia Slide.....	3	12 N.	10 E.				
	34	13 N.	10 E.		2,450		XV, pp. 281, 282, 292; XX, p. 8.

German.....	14	9 N.	10 E.	Seymour Hill, El Dorado.....	1,150	100	XIII, p. 142; XV, p. 286; Bull. 19, p. 90.
Gillespie.....	17	10 N.	10 E.	Charles E. Pine, Roseville, and Thomas Patton, El Dorado.....	-----	20	
Gold Bug.....	20	12 N.	12 E.	John I. Martin, Placerville.....	-----	20	
Golden Gate.....	14, 23	9 N.	10 E.	James Richards, Placerville.....	1,100	80	X, p. 171; XII, p. 117; XIII, p. 150; XV, p. 286.
*Golden State.....	29, 32	13 N.	10 E.	Ida Barklage Ackley, Georgetown; Emma B. Schutz, Arbuckle; Flora Barklage, Hotel Sacramento, Sacramento, John Federwitz, Auburn	2,600	20	XI, p. 204; XII, pp. 111-112; XIII, p. 143; XV, p. 287 (see also Georgia Slide); XIII, p. 143.
Golden Trace.....	27	10 N.	13 E.	Heirs of Catherine McBeath, Route A, box 117, Placerville.....	3,400	-----	
Golden West.....	28	11 N.	9 E.	Mrs. B. E. Carter, 811 E St., Sacramento and Mrs. L. S. Sanbin, Nashville.....	-----	21	
Gold Mountain and Monitor.....	11	8 N.	10 E.	Charles F. Loughbrow, El Dorado.....	800	40	XV, p. 286.
Gold Top.....	12	9 N.	10 E.	W. F. Deert, 995 Market St., San Francisco	-----	20	
Good Hope.....	24	8 N.	9 E.	Gopher-Boulder Mining Co., c/o W. F. I. Bell, Kelsey.....	-----	42	VIII, pp. 175-177; XIII, p. 143; XV, p. 287; Bull. 18, p. 98.
Gopher-Boulder.....	11, 14	11 N.	10 E.	Grand Victory Gold Mining Co., c/o George M. Clark, Placerville.....	1,950	-----	
Grand Victory.....	33, 34	10 N.	11 E.	John Meder, Folsom, et al.....	2,100	72	VIII, p. 194; X, p. 178; XII, p. 112; XIII, p. 143; XV, p. 287.
Green Valley.....	22	10 N.	9 E.	L. N. Hoskins, Route 4, box 180, Turlock.....	-----	8	
Greenwood.....	12, 13 7, 18	12 N. 12 N.	9 E. 10 E.	James Richards, Placerville.....	-----	25	
Griffith Cons.....	30, 31	10 N.	11 E.	-----	-----	82	VIII, p. 189; X, p. 172; XII, p. 112; XIII, p. 144; XV, p. 287; Bull. 18, p. 92.
Grit Cons.....	30	13 N.	10 E.	Harriet A. Baughman, 1430 P St., Sacramento.....	1,000-2,000	-----	
Gross No. 1.....	6	10 N.	11 E.	Placerville Gold Mining Co., Placerville.....	-----	24	XVII, p. 426; XVIII, p. 44; XX, p. 8; Pre. Rep. 8, p. 29.
Grouse Gulch.....	36 16	11 N. 9 N.	10 E. 13 E.	Mrs. K. Smith, Grizzly Flat and I. W. Smart, Placerville.....	-----	-----	VIII, p. 181; XII, p. 113 (see Pacific also).
Guadalupe.....	11	11 N.	10 E.	A. Merson and Sons, Placerville and Pioneer Hardware Store, Placerville.....	4,000	20	VIII, p. 179; XII, p. 113; XIII, p. 144; XV, p. 288.
*Guildford.....	36	11 N.	10 E.	-----	-----	10	
Hard Scabble.....	10, 15	10 N.	11 E.	Guildford Gold Mining Co., Placerville.....	2,000	500	XV, pp. 287-288.
Harrison.....	6, 7	10 N.	11 E.	Charles Varozza, Placerville.....	-----	135	
				Max Merson, Placerville.....	-----	16	

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TABLE OF QUARTZ MINES AND PROSPECTS, EL DORADO COUNTY—Continued.

Name of mine	Location			*Owner's name, address	Eleva- tion, feet	Area, acres	Bibliography
	Sec.	Twp.	Range				
Henrietta	20	10 N.	11 E.	Placerville Gold Mining Co., Placerville.	---	14	VIII, p. 186; X, p. 173; XII, p. 113 (see Pacific also).
Hickory	25	11 N.	10 E.	A. Everett Ball, 620 Mills Bldg., San Francisco.	---	35	
Hines-Gilbert	24	13 N.	9 E.	Hines-Gilbert Gold Mines Co., c/o H. P. Andrews, 510 Bryte Bldg., Sacramento.	900-1,900	32	XVII, p. 427; XVIII, p. 209; XX, pp. 178-179.
Homestead	26	13 N.	10 E.	Homestead Mining Co., c/o F. J. Blake, 604 Mills Bldg., San Francisco.	---	---	
Humiston	24	8 N.	9 E.	M. P. Powell, Latrobe.	---	---	
Ibid	21	9 N.	13 E.	Wm. Brown, Oleta.	---	---	
Ida and Edith	34, 35	12 N.	11 E.	R. W. Brooke, Placerville.	---	40	
Idaho	14, 23	9 N.	10 E.	Sidney Pringle, c/o E. C. Pringle, 354 Russ Bldg., San Francisco.	1,250	20	XV, p. 288.
Ida Livingston	12, 13	11 N.	10 E.	Ida Livingston Mining Co., c/o A. W. Craig, 1317 Oak St., San Francisco.	2,000	20	XV, p. 288.
Independence	27	12 N.	11 E.	Charles P. Croft, Fairplay; Mrs. Mayme Quinn, Placerville; Laura J. Schiff, Placerville.	---	8	
Independence	10	9 N.	10 E.	Independence Quartz Mining Co., c/o Howard Mountain, 57 E. Twenty-first St., New York.	3,000	20	XIII, p. 145; XV, p. 288.
Independence	5	13 N.	11 E.	Independence Mining Co., c/o W. H. Duffey, Michigan Bluff.	---	114	
Indian Hill	5	10 N.	11 E.	Warren Crocker, Fallon, Nev.	---	40	
Indicator, S. W. H., Martha L., Old More	4	12 N.	9 E.	Eugene E. Howland, Cool; Jesse B. Hooker, c/o Howland, Cool.	---	51	
Inez	1	8 N.	10 W.	Estate of S. H. Magness, c/o Mill B. Magness, 1609 Ninth Ave., San Francisco.	1,500	184	X, p. 171; XII, p. 114; XIII, p. 147; XV, pp. 282-283.
Isabell	3	11 N.	10 E.	M. P. Bennett, Placerville.	---	---	
Ivanhoe, Willimantic and Barney	28	12 N.	10 E.	Fred Schmader, Georgetown.	2,000	40	XV, pp. 288-289.
Jansen	15, 22	12 N.	10 E.	A. F. Forni, Placerville.	2,300	20	X, pp. 175-176; XII, pp. 114, 126; XV, p. 289.
Jennings	2	11 N.	10 E.	Dalmatia Mining Co., c/o W. F. I. Bell, Kelsey.	---	20	
Jones	22	11 N.	10 E.	J. M. Brown, Mrs. Allie Lange, Bakersfield, et al.	---	20	
	6	9 N.	11 E.		1,650	20	XV, p. 287; XVIII p. 45; XIX p. 142.

Josephine.....	7	13 N.	11 E.	J. A. Shields, Auburn.....	2,900	240	VIII, pp. 165-167; X, p. 178; XII, p. 114; XIII, p. 147; XV, p. 289.
Josh Billings.....	21	12 N.	10 E.	A. Sienop, Garden Valley; John Johns, Auburn; Chas. E. Hand, Placerville.....	-----	20	
Jumbo No. 1 to No. 4.....	11	9 N.	8 E.	White Rock Land, Mine and Dredge Co., c/o W. J. Scott, 1720 Pacific Ave., San Francisco.....	-----	80	
Jumper.....	27	10 N.	11 E.	Gabe Tanzi, Placerville.....	-----	80	
Keley.....	24, 25	11 N.	10 E.	Mother Lode Mines Co., Alfred Page, 576 Fifth St., Brooklyn, N. Y.....	1,800	32	XV, p. 289.
Lady Blanche.....	36	9 N.	12 E.	J. E. Stratton, San Francisco.....	4,480	60	XIII, p. 147; XV, p. 289.
Lady Emma.....	23	11 N.	10 E.	The Karolyi Mining Co., c/o H. Summerfield, 830 Market St., San Francisco.....	2,000	7	XIII, pp. 147-148; XV, p. 289.
La Moille, Ophir.....	11	9 N.	10 E.	Walter I. Bidstrup, El Dorado.....	2,000	24	XII, p. 115; XIII, p. 148.
Larkin.....	29, 30	10 N.	11 E.	Larkin Mining Co., San Francisco.....	-----	28	XIII, p. 148; XV, p. 289; Bull. 18, p. 93.
Last Chance.....	8, 17	11 N.	10 E.	Martha D. Frantz, 2818 O St., Sacramento; B. L. Heikens, Coloma.....	1,400	1,427	XIII, p. 148; XV, p. 289.
Last Chance.....	15	10 N.	11 E.	Charles Varozza, Placerville.....	-----	274	
Leavitt Cons.....	30	11 N.	11 E.	A. F. Leavitt, 354-5 I. W. Hellman Bldg., or 5451 Huntington Drive, Los Angeles.....	2,350	20	XIII, pp. 148-149; XV, p. 289.
Lincoln.....	25	11 N.	10 E.	P. F. and Jas. L. Morgan, Georgetown.....	-----	20	
Little Emma.....	34	10 N.	13 N.	W. F. Detert, 995 Market St., San Francisco.....	1,775	4	XII, p. 116; XIII, p. 149.
Little Valley.....	3	11 N.	9 E.	Dacia G. Martin and Wm. Rider, Sacramento.....	-----	26	XII, p. 116; XIII, p. 149; XV, p. 289.
Live Oak.....	6	8 N.	10 E.	E. T. Cook, R.F.D. 4, Flandread, Moody Co., S. D., and N. H. Cook, 47 Summer St., Rutland, Vt.....	900	20	X, p. 176; XII, p. 116; XIII, p. 149.
Log Cabin.....	30	9 N.	10 E.	Campbell and Metson, San Francisco.....	2,000	20	X, p. 178; XII, p. 116; XIII, p. 149; XV, p. 290.
Lone Jack.....	28	12 N.	10 E.	Estate of J. C. Heald, Nashville.....	900	-----	XII, p. 116; XIII, p. 149; XV, p. 290.
Lone Star.....	11	8 N.	10 E.	D. H. Jackson, Box 112, La Jolla, Calif.....	1,600	20	XII, p. 116; XV, p. 290; XVIII, p. 45.
Lone Star.....	31	10 N.	11 E.	Seymour Hill, El Dorado.....	2,900	53	XIII, p. 149; XV, p. 290.
Lookout.....	11	9 N.	10 E.	Wilson Cary, Georgetown.....	1,700	14	XV, p. 290.
Lookout and K. K.....	19	13 N.	11 E.	L. T. Loveless and Brothers, El Dorado.....	-----	60	
Loveless.....	11, 14	9 N.	10 E.	Lucero Co., 916 Stock Exchange Bldg., Los Angeles.....	2,875	18	XIII, p. 149; XV, p. 290.
Lucero, Lillian, No. 1 and No. 2.....	21	12 N.	10 E.	Mrs. Nail, and D. Gallagher, Grizzly Flat.....	1,800	18	XV, p. 290.
Lucinda.....	22	12 N.	10 E.	Thomas Murphy, Logtown.....	1,830	20	XIII, p. 150; XV, p. 290.
Lucinda.....	11	9 N.	10 E.	Lucky Marion Mining Co., 619 St. Charles St. Louis.....	-----	-----	XIX, pp. 142-143.
Lucky Jack.....	12	12 N.	9 E.	Estate of G. E. Lukens, J. E. Lukens, Auburn.....	-----	-----	
Lucky Marion.....	12	12 N.	9 E.	-----	-----	-----	
Lukens.....	25	12 N.	8 E.	-----	-----	-----	

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TABLE OF QUARTZ MINES AND PROSPECTS, EL DORADO COUNTY—Continued.

Name of mine	Location			*Owner's name, address	Elevation, feet	Area, acres	Bibliography
	Sec.	Twp.	Range				
Maltby.....	17	12 N.	10 E.	A. F. Ford, Auburn.....	2,700	20	XI, p. 204; XV, p. 290.
Mameluke.....	3	12 N.	10 E.	P. F. and James L. Morgan, Georgetown.....	1,100	130	VIII, p. 117; XIII, p. 150; XV, p. 290.
Mammoth.....	3, 4	10 N.	9 E.	Dora W. Jurgens, Rescue.....		22	
Manhattan Cons.....	36	9 N.	10 E.	Nellie A. White, Box 695, Coalinga, et al.....	1,600	77	XV, p. 291.
Manzaneta.....	24	11 N.	10 E.	Mrs. G. C. Baum.....	1,500-1,800		Field report.
Marguerite.....	29	10 N.	11 E.	Marguerite Mining Co., c/o W. W. Tenney, Sec., 510 Battery St., San Francisco.....	2,000	17	XV, p. 291.
Martinez.....	12	9 N.	10 E.	Martinez Gold Mining Co., W. G. Busick, Pres., El Dorado.....		18	
Mathenas Creek.....	31	10 N.	11 E.	Mathenas Quartz Mines and South Co.....	1,800	132	XV, p. 288.
Sam Martin.....	6, 7	12 N.	10 E.	Ella S. Graves, Lock box 7, East Liverpool, O.....		20	VIII, p. 190; X, p. 172; XII, p. 117; XIII, p. 150; XV, p. 291.
McCarty.....	7	9 N.	9 E.	E. A. Stent, Humboldt Bank Bldg., San Francisco, and W. C. Watson, 926 Folsom St., San Francisco.....		21	
McDowell and Wiltshire.....	36	9 N.	10 E.	W. B. Hammell, El Dorado, et al.....		20	
Meder Lode.....	17	9 N.	10 E.	Michael B. Ryan, Shingle Springs.....		40	
Melton.....	4	9 N.	13 E.	Isaac P. Lampson, Cleveland, Ohio.....	3,800	54	VIII, pp. 177-180; XII, p. 117; XIII, p. 150; XV, p. 291.
Michigan.....	35	9 N.	12 E.	Mrs. Phoebe A. Quick, c/o Mrs. J. W. Morton, 326 S. Michigan Ave., Big Rapids, Mich.; C. G. Woodburn.....			
Miller.....	30, 31	13 N.	10 E.	C. O. Miller, 2214 M St., Sacramento.....		96	VIII, p. 189; X, p. 172; XII, p. 122; XIII, p. 150; XV, p. 291.
Miller.....	20	10 N.	11 E.	Mary E. Goyan, Placerville.....	1,800	20	
Minnehaha.....	11	9 N.	10 E.	Minnehaha Gold Mining Co., c/o R. W. Payne, Thirty-fourth St., San Francisco.....			
Monarch Cons.....	12	8 N.	10 E.	Lansing Stout, c/o Hibernia Savings Bank, Portland, Ore.....			
Montana.....	19	13 N.	11 E.	J. Helmers, Georgetown, et al.....	2,680	137	XIII, p. 151; XV, p. 291.
Montezuma.....	2	8 N.	10 E.	Estate of J. C. Heald, Nashville.....	900	20	XII, p. 118; XIII, p. 151; XV, p. 291; Bull. 18, p. 91.
Morey.....	35	9 N.	10 E.	E. R. Morey, Grizzly Flat.....			VIII, p. 178; X, p. 178; XII, p. 118; XIII, p. 151; XV, p. 291.
Morey.....	16	9 N.	13 E.		3,600	40	

Morning Star, Lucky Girl, Evening Star, Lucky Boy.....	2	12 N.	10 E.	E. F. Porter, Georgetown.....	80	
Mountain Boy, Mountain Girl, Mountain Slide, Eastern Star.....	33 34	12 N. 10 N.	10 E. 13 E.	Jessie L. Whittle, 1716 Webster St., Oakland-Sieran Mining Co., c/o Judge Wildman, Norwalk, Ohio.....	20	
Mount Pleasant.....	16	9 N.	13 E.	W. S. Kirk, Placerville.....	40	XII, p. 114; XIII, p. 151; XV, p. 292.
Mulvey Point and Pacific.....	34, 35	13 N.	10 E.	Ida Barklage Ackley, Georgetown; Flora Barklage, Hotel Sacramento, Sacramento; Emma B. Schutz, Arbuckle; Catherine Reinhard, Georgetown; Mrs. A. B. Wiesen, 720 Seventeenth St., Sacramento.....	259	VIII, p. 178; X, p. 178; XII, p. 118; XIII, p. 151; XV, p. 292; XVIII, pp. 209, 301.
Murry.....	17	8 N.	13 F.	Hayward, Hobart and Lane Estates, 1128 Merchants Exchange Bldg., San Francisco.....	40	XV, p. 292 (see also Georgia Slide).
Nashville.....	2	8 N.	10 E.	Joshua Handy Iron Works, 75 Fremont St., San Francisco.....	32	
New El Dorado.....	36	13 N.	9 E.	New El Dorado Mining Co., c/o E. Jennings, Box 1547, Route 4, Napa.....	60	XII, p. 119; XIII, p. 151; XV, p. 299; XVIII, pp. 45, 209; Pre. Rep. 8, p. 30; Bull. 18, p. 91.
New Garibaldi.....	1	12 N.	9 E.	J. B. Hayes, San Francisco.....	20	XII, p. 119; XIII, p. 152.
North Star.....	33	11 N.	11 E.	Henry Ashcroft, Mary Ralph, Placerville; Mrs. Anna Ward, Placerville.....	20	XIII, p. 152; XV, p. 293
Oak.....	4, 5	8 N.	13 E.	J. Ryan, Grizzly Flat.....	7	
Ohio and Eagle.....	7	12 N.	10 E.	Thomas Holder, Greenwood.....	35	XII, p. 119; XIII, p. 152; XV, p. 293.
Old Jasper.....					18	XII, p. 119; XIII, pp. 152, 157; XV, p. 293.
Old Judge.....	12	11 N.	10 E.	Old Judge Mining Co., c/o Mary A. Murphy, 57 Post St., San Francisco.....	80	XIII, p. 152.
Olive.....	18 7	12 N. 12 N.	10 E. 10 E.	Sarah J. Dorn, 812 Phelan Bldg., San Francisco.....	40	
Omo.....	32	9 N.	13 E.	G. W. Mock, Omo Ranch.....	60	XIII, pp. 152-153; XV, p. 293.
One to Sixteen and Vulture.....	6, 7	10 N.	11 E.	W. A. Craddock, Placerville.....	25	XV, p. 293.
Oregon.....	18	10 N.	11 E.	Pardi Iritiza, Placerville.....	11	VIII, pp. 182-183; X, p. 173; XII, p. 119, XIII, p. 153.
Oriflamme.....	31	10 N.	11 E.	Estate of S. H. Maginess, c/o Mill B. Maginess, 1607 Ninth Ave., San Francisco.....	20	VIII, pp. 189-190; X, p. 172; XV, p. 293.
Oro Fino.....	29	9 N.	10 E.	Hayward, Hobert and Lane Estates Co., Merchants Exchange Bldg., San Francisco.....	59	VIII, pp. 174-175; XV, p. 293; XVIII, p. 209.

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TABLE OF QUARTZ MINES AND POSPECTS, EL DORADO COUNTY—Continued.

Name of mine	Location			*Owner's name, address	Elevation, feet	Area, acres	Bibliography
	Sec.	Twp.	Range				
Oro Fino-----	33	12 N.	10 E.	Lessee, Sam Collins, Garden Valley, Mrs. Alva Archer, 1716 H St., Sacramento, et al.			
Orum-----	12	9 N.	10 E.	Orum Mining and Development Co., O. A. Ingraham, Placerville.	1,250	45	XV, p. 300.
Pacific-----	17, 18	12 N.	10 E.	Placerville Gold Mining Co., c/o A. Boring Gould, Placerville.	1,950	1,400	VIII, pp. 183-186; X, p. 173; XI, p. 203; XII, p. 120; XIII, p. 163; XV, pp. 293-295; XVIII, p. 209 (Includes Epley, Pacific, Mammoth, Albright Henrietta, Faraday, Maryland, Old Harmon, Young Harmon, Gross Nos. 1 and 2 et al.) XII, pp. 120-121; XIII, p. 153; XV, p. 295.
Philadelphia and Gold Note-----	21, 22	8 N.	13 E.	J. B. Polk and Parker Bros., Orno Ranch.	4,000	70	
Phillips and Joiner, Treat Ext. and Frost Channel-----	39, 4	9 N.	13 E.	Melton Quartz Mining Co., c/o J. L. Jennings, Hotel Coronado, Coronado Beach, Calif.		27	
Pine Hill-----	7	10 N.	10 E.	Pine Hill Gold and Silver Mining Co., 407 Front St., San Francisco.			
Pocahontas-----	12, 1	10 N.	9 E.		1,060	230	XII, p. 121; XIII, p. 153.
	10, 11	9 N.	10 E.				XII, p. 121; XIII, p. 154; XV, p. 295; Bull. 18, p. 95.
	14, 15	9 N.	10 E.	Eunie M. Chase, 26 O'Farrell St., San Francisco.			
Polar Bear, White Bear, Empire Group-----	29, 32	9 N.	13 E.	J. T. and J. Q. Wrenn, Placerville.	4,000	404	XV, p. 295.
Pony-----	18	12 N.	9 E.	W. E. Smith, Cool.			
Pyramid-----	12, 13	10 N.	9 E.	Pyramid Mine and Mill Co., c/o C. F. Crothers, 32 E. Santa Clara St., San Jose.			
Rainbow-----	21	12 N.	10 E.	J. Ramsdell and C. M. Root, Garden Valley.	2,200	20	XII, p. 121; XIII, p. 154; XV, p. 295.
Rattler-----	20	10 N.	11 E.				XIII, p. 155; XV, p. 295.
Red Rover-----		10 N.	9 E.				XII, p. 122; XIII, p. 155.
							XII, p. 122; XIII, p. 155; XVII, pp. 427-428.
Red Wing-----	14, 23	9 N.	10 E.	W. H. Jones, J. E. Lawyer, P. J. Loveless, El Dorado.			
Reed and Keyser-----	17	10 N.	11 E.	John F. Limpinsel Estate, Placerville.	1,200	20	XV, p. 296; XVIII, p. 301.

Richelieu	14, 12	9 N.	10 E.	Richelieu Mining Co., c/o E. W. Hopkins, 354 Pine St., San Francisco.		20
Richmond and Syracuse	4	8 N.	13 E.	Mary Witmer, Placerville.	3,300	XV, p. 296.
River Hill	33 6 36	9 N. 10 N. 11 N.	13 E. 11 E. 10 E.	G. M. Clark, Placerville, and Guildford Gold Mining Company, Placerville.	2,000	X, p. 177; XII, p. 111; XIII, pp. 141-143; XV, p. 296; Bull. 18, p. 94 (see Gentle Annie also).
Rising Sun	11, 14	11 N.	10 E.	A. F. and J. C. Pedrine, c/o J. C. O'Donnell, Placerville, and A. F. Forni, Placerville.	1,850	XV, p. 296.
Rose	6	11 N.	9 E.	Henry H. Rose, Auburn.		VIII, pp. 182-183; XII, p. 122; XIII, p. 155 (see Pacific also).
Rose	18	10 N.	11 E.	Placerville Gold Mining Co., c/o A. Barring Gould, Placerville.		
Rosecranz	21	12 N.	10 E.	Geo. Steppe, Placerville, Chas. R. Young, Pajon; Lillie and Wm. Crook, c/o Arthur S. Morey, 660 Eleventh Ave., San Francisco; Sallie Mitchell, Placerville; A. Siesnop, Garden Valley and Josephine F. Simpers, 1559 Sacramento St., San Francisco.	2,100	VIII, p. 171; X, p. 176; XII, p. 122; XIII, p. 155; XV, p. 296.
Rose Kimberly Nos. 1 and 2	11, 10	10 N.	9 E.	Rose Kimberly Mine, c/o J. O. Evans, 975 Flood Building, San Francisco.		150
Rubicon and Alhambra	15	13 N.	11 E.	Ida Barklage Ackley, Georgetown; Emma B. Schutz, Arbuckle; Flora Barklage, Hotel Sacramento, Sacramento.		34
Ruxford	7	12 N.	10 E.	E. H. Ruxford, Title Insurance Bldg., 275 Bush St., San Francisco.		X, p. 178.
Ryan	24	11 N.	10 E.	M. B. Ryan, Placerville and Barrett Bros., Shingle Springs.		20
San Leandro	1	9 N.	10 E.	Tullis Quartz Mining Co., c/o Charles T. Hale, First Nat'l Bank, San Leandro.	2,000	XV, p. 296.
School Girl	12	9 N.	10 E.	Oakland Bank of Savings, c/o Charles Hussey, 507 Empire St., Box 1724, Spokane, Wash.		15
Selby	29	10 N.	11 E.	Warren Larkin, Placerville.	1,900	(Part of Union.) XV, p. 296; Bull. 18, p. 93.
Shan Tsz	21	10 N.	10 E.	H. DeC. Richards, 621 Crocker Bldg., San Francisco.	1,650 2,400	XV, pp. 296-297. VIII, p. 194; XII, p. 123; XIII, p. 156.
Sharp						
Sheehan	28	11 N.	9 E.	V. C. Sheehan, 216 Pine St., San Francisco.		10
Sherman	8	10 N.	11 E.	Sherman Mine and Milling Co., Placerville.	2,000	XV, pp. 297-298.
Sleeping Beauty	12	8 N.	10 E.	Martha S. Kercheval, R. F. D. Box 27, Courtland; C. M. Chubb, Vacaville.		10

* Ownership given in this table is that shown in county tax records.

TABLE OF QUARTZ MINES AND PROSPECTS, EL DORADO COUNTY—Continued.

Name of mine	Location			*Owner's name, address	Elevation, feet	Area, acres	Bibliography
	Sec.	Twp.	Range				
Sliger	25	13 N.	9 E.	Sliger Gold Mining Co., c/o W. H. Simpser, 3628 Fulton St., San Francisco	2,000	47	XII, p. 123; XIII, p. 157; XV, p. 297; XIX, p. 143; M. R. West of Rocky Mountains, 1873, p. 47.
Spanish Hill	17	10 N.	11 E.	Pioneer Hardware Store, Placer ville.	2,100	50	XII, p. 123; XIII, p. 157; Field Report, 1919.
Santa Claus	7	12 N.	10 E.	Santa Claus Mining Co., c/o Emma P. Polcaro, 1503 Albesandro St., Los Angeles		20	
Starlight	10	9 N.	10 E.	Starlight Mining Co., 206 Sansome St., San Francisco		20	XII, p. 123; XIII, p. 157; XV, p. 298.
St. Clair	14	11 N.	10 E.	John Peters and Thomas Gregory, Kelsey	1,750	20	
Steele and Dryden	12	11 N.	10 E.	John Quiggle, Galt	2,100	20	XV, p. 298.
Stillwagon	32, 33	9 N.	13 E.	C. A. Querolo, 892 Isabella St., Oakland	3,000- 3,300	30	X, p. 178; XII, pp. 123-124; XIII, p. 158; XV, p. 298.
St. John	34	13 N.	11 E.	Geo. F. Hawkins, 1810 Tenth St., Sacramento; Hattie M. Wilson, 858 S. Philadelphia St., Ana- heim; Irene N. Wilson, c/o Customs House, San Francisco and John Boggs, 130 N. Cali- fornia St., Stockton		30	XI, p. 202; XII, p. 173; XIII, p. 156; XV, p. 298.
St. Lawrence	2, 11	11 N.	10 E.	A. Miersen and Sons, Placerville; Pioneer Hard- ware Store, Placerville	2,200		
St. Louis	14, 24	9 N.	10 E.	James Richards, Placerville		17	
Stuckslager	24	11 N.	9 E.	C. T. Arper, 212 S. Cordova St., Alhambra; Anna M. McKinney, 1821 N St., Sacramento	825	20	VI, p. 43; XII, p. 124; XIII, p. 158; X, p. 178; XV, p. 298.
Sunday	4, 9	9 N.	13 E.	E. W. Witmer and John Melton Estate, Placer- ville	4,000	20	XII, p. 124; XIII, p. 158; XV, p. 298.
Sun Rise	24	11 N.	10 E.	Phillip L. Barrette, Shingle Springs	2,350	10	XIII, pp. 158-159; XV, p. 299.
Superior	30	10 N.	11 E.	Rose Emma, c/o Garrett W. McEnerny, 2002 Hobart Bldg., San Francisco	1,800	20	VIII, pp. 187-189; X, p. 172; XII, p. 124; XIII, 159; XV, p. 299.
Sutter Mill Bar and River	17	11 N.	10 E.	W. D. Othick, c/o C. A. Carver, Coloma		11	(Site of Sutter's Mill, 1848).

Swansed.....	10, 15 3	10 N. 11 N. 11 N.	11 E. 10 E. 10 E.	Ernest W. Schlein.....	50	
Swanson and Rocky Bend.....	10, 15	11 N.	10 E.	W. E. and H. E. Kleinsorge, 605 J St., Sacramento		
Sylvester.....	32	11 N.	10 E.	Charles H. Clifton, Rt. A, Placerville	20	
Taylor.....	21	12 N.	10 E.	W. E. Deane, San Francisco.....	18	VIII, pp. 168-171; X, p. 176; XI, p. 205; XII, p. 113; XIII, p. 145; XV, p. 299; XVIII, pp. 209, 210.
Threlkel.....	16	11 N.	8 E.	L. L. Threlkel and Margaret Threlkel, Newcastle.	120	
Tip Top.....	12	9 N.	8 E.	J. E. Ebert, P. O. Box 231, Marysville.	120	
Tong.....	4	9 N.	13 E.	J. H. Tong, Clarksville.	11	
Treat.....				Mrs. John D. Treat, Oakland.....	40	VIII, p. 178; XIII, p. 159; XV, p. 299.
True Cons.....	6, 7	10 N.	11 E.	Placerville Gold Mining Co., c/o A. Baring Gould, Placerville.....	2, 310	VIII, pp. 180-181; XII, p. 125; XIII, pp. 144, 159 (see Pacific Mine also). XIII, pp. 159-160; XV, p. 299.
Tullis.....	1	9 N.	10 E.	Tullis Mining Co., San Leandro.....	1,700	
Uncle Sam.....	3 35	12 N. 13 N.	10 E. 10 E.	Adolph and C. Beattie, Georgetown.....	20	
Union.....	11, 12 13, 14	9 N. 9 N.	10 E. 10 E.	Estate of John A. Finch, c/o Chas. Hussey, 507 Empire State Bldg., Spokane, Wash.....	19	XIII, p. 160.
Up-to-date.....	36	13 N.	9 E.	Paul Ricci, Greenwood.....	219	VI, p. 43; VIII, p. 167; XV, p. 209; XVIII, pp. 209, 210; Bull. 18, p. 92.
Valdora.....	19	9 N.	10 E.	F. H. McAfee, Grizzly Flat.....	40	VIII, p. 178; XIII, p. 161.
Vandalia.....				Fred McCall, Lessee Sutter Hotel, Sacramento		VIII, pp. 172-173; X, p. 178; XII, p. 126; XVIII, p. 301; XX, p. 178; Bull. 18, pp. 96-98.
Vandergreft.....	26 6 36	9 N. 10 N. 11 N.	10 E. 11 E. 10 E.	J. P. Vandergreft, Placerville.....	40	XV, p. 300.
Van Hooker.....				Placerville Gold Mining Co., c/o A. Baring Gould, Placerville.....		VIII, p. 181; X, p. 173; XIII, p. 161; (see Pacific also).
Varn.....	2	12 N.	10 E.	W. L. Dickerson, San Francisco.....	20	XI, p. 203; XII, p. 126; XIII, p. 161; XV, p. 300.
Victoria Lode.....				Grimshaw, Faris and Cornelius, Rescue.....		XX, p. 178.
Volcano.....	5, 8	8 N.	13 E.	Hayward, Hobart and Lane Estate Co., 1128 Merchants Exchange Bldg., San Francisco.....	67	XVIII, p. 301.
Von Kotsch and Moore.....				D. C. Webster, Georgetown.....	24	XII, p. 126; XIII, p. 161; XV, p. 300.
Webster.....	21	13 N.	11 E.	Henry Welch Mining Co., San Francisco.....	20	XII, p. 126; XIII, p. 161; XV, p. 300.
Welch.....	7	12 N.	10 E.			

* Ownership given in this table is that shown in county tax records.

TABLE OF QUARTZ MINES AND PROSPECTS, EL DORADO COUNTY—Continued.

Name of mine	Location			*Owner's name, address	Elevation, feet	Area, acres	Bibliography
	Sec.	Twp.	Range				
Weske.....	3	12 N.	10 E.	Adolph Weske, c/o L. L. Clark, 501 S. Seville Ave., Huntington Beach.		38	
Dan Wicham.....	24	9 N.	10 E.	Sarah A. Culbertson and Elizabeth Mason, Placerville.			XVII, p. 428.
Wiedebush.....	20	13 N.	11 E.	Mrs. Sophia Cornelius and Alex Lauritzen, Newcastle; Estate of Frank P. Holt, c/o J. B. Blair, Placerville.			
Wild Goose.....	16	11 N.	8 E.	Estate of F. H. Maginess, c/o Mill B. Maginess, 1607 Ninth Avenue, San Francisco.			
Wild Rose Cons.....	13	9 N.	10 E.	Estate of G. E. Lukens, Auburn.	1,500	18	Field Report. (See Lukens.)
Wilhelm and Last Chance.....	25	12 N.	8 E.	Elizabeth M. Green, 1723 K St., Sacramento, and Joseph H. Woolford, Plymouth.	1,200	67	
Wiltshire.....	36	9 N.	10 E.	H. A. Winton, Newcastle.		40	
Winton.....	17	11 N.	8 E.	Woodside-Eureka Mining Co., c/o R. B. Myers, 204 Bacon Block, Oakland.		6	
Woodside-Eureka.....	2, 3	12 N.	10 E.			18	
Yellow Jacket.....	18	13 N.	11 E.	Trench Brothers, c/o Mrs. Rush Walker, 1 Copleys St., Winchester, Mass.	2,700	116	XI, p. 200; XII, p. 126; XIII, p. 161; XV, p. 300.
Zantgraf and Homestead.....	17, 20 21	11 N. 11 N.	8 E. 8 E.	P. C. Drescher, c/o Mebius and Drescher, Front and K St., Sacramento.	3,000	28	XII, p. 125; XIII, p. 159; XV, p. 299.
Zantgraf Ext.....	16	11 N.	8 E.	A. J. Zantgraf, R.F.D. 91, Newcastle.	500	254	VIII, pp. 200-202; X, p. 178; XIII, pp. 161-162; XV, p. 300; XVIII, p. 209; XX, p. 8.

* Ownership given in this table is that shown in county tax records.

GOLD (PLACER MINES).

Placer mining in El Dorado County during the time since our last report has been generally on a small scale and few, if any, operations are continuous. A few men, usually not over two or three at a property, carry on work during the winter and spring when water is available, and they produce part of the small annual gold output of the county.

Coloma, the site of James W. Marshall's gold discovery in January, 1848, is now a fruit raising district. North of Georgetown some unworked gravel remains in deep channel deposits some of which were worked in part in very early days. There are numerous seam mines also in the northern part of the county, which have paid well. The largest of these are at Georgia Slide.

Georgia Slide diggings, two miles north of Georgetown on Canyon Creek, paid good profits to the hydraulic miners who washed the upper part of the deposit. There are numerous mining claims, among which the *Beatty and Parsons* claims worked almost continuously from 1853 until 1895, when the use of a hydraulic giant on the claims was ordered stopped. The Georgia Slide deposit is essentially an immense lens-shaped, low-grade orebody 400 feet in maximum width, in which gold occurs free in numerous narrow seams and veinlets of quartz in the black Mariposa slate and accompanying schist and altered igneous rocks, and also in sulphides. While really a gold quartz deposit in place, it was found at an early date that it could be worked best by hydraulicking and this method was followed here and at numerous other similar mines in the northern part of the county. The deposits are loose and oxidized to depths of 100 to 150 feet. They were blasted and washed through sluices in the regular way at low cost. Several such mines were worked until the fresh, hard rock was reached. Some years ago the Georgia Slide mines were extensively sampled by a company that hoped to make a large low-grade quartz mine, but the project was not carried out, and the average value revealed by their sampling cannot be learned, although such ground often paid \$2 to \$3 a cubic yard.

Canyon Creek received the gold from the natural erosion of the Georgia Slide seam deposit, as well as the tailings from the mines mentioned as having operated there so long. This accumulation is interesting as a mining possibility, as mentioned elsewhere.

River mining on the two forks of American River is practically a thing of the past. There are few places left in these stream beds where it is known certainly that unworked ground remains, as there is scarcely a man living today who has been acquainted with the full history of river mining, which began in 1848. Most of these river mines were worked previous to 1885, by damming the stream and running it through large flumes during the summer months of low water.

Often the first fall freshet caught the miner with the ground only partly cleaned up, and he lost his entire equipment. The richness of some portions of the stream is attested by the fact that the operator would return year after year until a favorable season made possible a good clean-up. Such ground can now be sampled and mined without dams or flumes as mentioned herein under the Boles Mine. Some interesting ground remains on the Middle Fork of Cosumnes River at Rocky Bar, adjoining the old Cosumnes copper mine, where the stream flows

over an area of limestone, and has deposited gravel in potholes and caverns. Some work has been going on at Little Big Hole, a mile distant from the above on the same stream.

Some drift mining has been done recently at Smith's Flat, but drift mines near Placerville, Pacific House, Grizzly Flat and Newton have remained idle. The deep drifting ground at Smith's Flat and Placerville has been pretty well exhausted. Small, irregular operations are carried on near Caldor (Henry Diggings), Indian Diggings and Slug Gulch. The following notes summarize placer prospecting activities in the county during the past ten years.

At the *Boles Placer Claim* on the North Fork of American River three miles upstream from Rattlesnake bridge, a part of the river bed which was supposed to have remained unworked was prospected in 1924 and 1925 by combined diving and pumping operations. The place prospected was the upper end of a hole containing deep water at all seasons, and a heavy accumulation of gravel and boulders of all sizes, on amphibolite schist bedrock.

A barge, anchored in the stream by cables, carried the air pump and small engine used to supply air for the diver. Due to the amount of low grade gravel that had to be moved to reach the supposed virgin deposit on bedrock and in the crevices, a heavier outfit was installed. The second barge carried a 40-h.p. gasoline engine and 6-inch centrifugal gravel pump, besides the complete diving outfit. An overhead cable spanned the river and a hoist and engine on shore operated a steel scoop which could be lowered into the river from this cable and filled with large rocks by the diver, who worked under water. The diver directed the suction nozzle of the pump, which picked up everything small enough to pass through the pipe. The pump discharged its load of gravel and water into the head of the sluice boxes, about six feet above water level, giving ample water for washing the gravel and sufficient grade for the sluices to permit discharging the tailing downstream on the bank. Work could only be carried on when the water was clear, and was warm enough to permit the diver staying under some hours. Two divers alternated under water and five in all were employed. The method appeared to be a good one for handling small yardages of high grade gravel, but in this case results were disappointing as it was found that the small area prospected had been worked years before. The yardage that can be handled depends on the number and size of boulders which have to be handled by the diver and hoisted, as this interrupted his work with the pump. The work was done under as much as 20 to 24 feet of water at times. The diver under water can handle boulders easier than in the air, due to their loss in weight. E. L. Rene and E. C. Smale were in charge of work.

Danaher or Roundout Mine $2\frac{1}{2}$ miles northwest of Smith's Flat was mentioned in our Seventeenth Report. It has remained idle since 1919, when an incline and bedrock crosscut were being run to reach an unworked part of the channel.

Gold Bug Mine contains 101 acres, covering 4000 feet in length along Canyon Creek beginning just below Georgia Slide. The deposit consists of the accumulation of hydraulic mining tailings from the Georgia Slide mines and the material from the previous erosion of the auriferous seam belt. In 1922, as described in our report for that year, an outfit

consisting of dragline scrapers, hoist, trommel, etc., for digging and washing the gravel, was installed by the Kelliher Mining Company. This company experimented for several years with different methods of working the ground, but were not successful.

Grizzly Flat Placer Mine has lain idle since 1918. The original owners, except one, have died. The property is equipped with a 10-stamp mill. The gravel is a part of the Tertiary Channel filling of the Mokelumne River, a short distance north of Grizzly Flat. It is a wide thin deposit of cemented gravel, carrying \$1 to \$9 a cubic yard in gold. The late owners produced \$12,000, but claimed their work was on the rim and that 300 feet of new tunnel would be required to get into the channel, which had been partly worked at an earlier date through an old tunnel. Wm. Voss, Grizzly Flat, is the only one of the former owners left there, the other interests being in several estates.

The *High Tunnel Mine* is on an old high channel deposit on the south side of the South Fork of American River, just northeast of White Rock Canyon, and $3\frac{1}{2}$ miles from Placerville. A. C. Lancaster, R. F. D., Placerville and K. N. McNaughton are working it under lease. Besides the early day work, there is a tunnel 500 feet long which the lessees have extended 50 feet. Wm. Martin, Sacramento, owner.

Hook and Ladder (Toll House) Mine is at Smith's Flat and is the only one in that district recently active. The work done from 1918 to 1920 was described in our Seventeenth Report, 1920, p. 428. After that time, it was taken under lease and option by Pioneer Gold Dredging Company, 433 California Street, San Francisco. As described by Bert Bryan, superintendent, it appeared that when the ancient stream struck a hard reef of granitic bedrock, it narrowed and cut a trench in which little or no gravel was deposited. The later work has been devoted to running downstream to get past this, in the hope that the stream would widen and show payable gravel below. The shaft is 148 feet deep. The old upper level has been advanced 620 feet and is now 1000 feet long, south of shaft. A crosscut from rim to rim is 500 feet long on the upper level. This level is reported in gravel six inches to four feet deep for a length of 160 feet. The lower level, which was 300 feet long in 1920, is 30 feet below the upper one, and has not been advanced recently, but may have to be driven 500 feet farther to reach the gravel which is believed to widen ahead. It is thought this lower level will give sufficient depth to work the gravel through raises. Work had been suspended in October, 1926 pending decision as to future operations. The gold taken out recently is said to have sold for \$20.40 an ounce.

The so-called deep blue lead at Smith's Flat was worked extensively years ago on both ends of this property, which is thought to have 1000 feet of possible channel left. Besides the deep channel, remnants of a higher and older white quartz channel were found in the form of benches above the deep trough. The gravel in the basin was below the present surface and was worked through inclines and vertical shafts.

Andrew Hutchinson and *Charles Woodburn* operate a drift mine at *Slug Gulch*, three miles from Fairplay.

W. A. Jinkerson and *J. Arditto* are drifting gravel at Indian Diggings through an adit several hundred feet long.

The *J. C. McKim Gravel Mine* near Caldor (Henry Diggings) three miles south of Grizzly Flat has been prospected in 1926 under the direction of G. W. Seybolt, trustee for the owners. It is supposed to be on the Tertiary Mokelumne channel, that flowed south from Grizzly Flat. An adit was run about 100 feet and a raise put up 20 feet is said to have struck rim gravel in July, 1926. Work had been suspended late in October, 1926, as there was no provision for working in winter.

Little Big Hole Placer is on the Middle Fork of Cosumnes River five miles northeast of Fairplay, and a mile upstream from the Rocky Bar Mine. A Los Angeles company represented by H. Hardesty has employed four or five men during the past summer and they are said to have diverted the river through a flume preparatory to working a hole about 250 feet long. George W. Wood, Placerville, owner.

Pacific Channel Mine at Pacific House suspended work several years ago. It was described in our Seventeenth Report, 1920, page 428.

Rising Hope Drift Mine has remained idle since the death of the last superintendent, George W. Englehardt, in 1920. It was described in our report for that year, page 429.

Rocky Bar Placer contains 51 acres, patented, and covers 800 feet along the Middle Fork of Cosumnes River in Sec. 25, T. 9 N., R. 12 E., a mile by steep trail from Grizzly Flat road near Coles or five miles by road from Fairplay. T. A. McMurray, Coles Station, (Grizzly Flat P. O.) et al., owners.

The river here crosses a limestone area and has formed caverns and potholes in which gravel has been deposited, a depth of 45 feet having been reached in one place without reaching bedrock. It has been worked to water level and also wing dammed on one side, but is said to contain considerable unworked deep ground. The ground is quite rocky.

Equipment includes a donkey engine, derrick, 4-inch and 6-inch centrifugal pumps, 2 gasoline automobile engines, small tools, and cable. There are some cabins on the claim. Idle.

It was last worked by Barbara Mining Company in 1924, when a crew of men were employed and equipment brought in. Apparently they were unsuccessful.

On the claims of the *White Rock Land, Mine and Dredge Company* on Carson Creek about one mile west of Clarksville, several attempts have been made in the past few years to work the shallow creek gravel with a dragline scraper outfit. The last run was made in the winter of 1925-26, and since then the equipment has been partly removed.

The gravel has been worked in the past by drift and surface miners and is said to be spotty in gold content. Water sufficient for washing it is available only for about three months in the rainy season.

A great many placer claims are held by locators in this county and there is also quite a large acreage of patented placer mines in the county. A full description of all these can not be entered into here, and is not considered necessary as the subject has been covered in detail in publications mentioned below. Practically all these mines have suspended work and are at present inaccessible. Little or nothing could therefore be added in the way of real knowledge concerning the underground geology. A list of names, ownership, location and other

data concerning most of the placer mines is available at our Sacramento office.

Principal Publications on Placer Mining in El Dorado County.

United States Geological Survey:

Professional Paper No. 73.

Folio Reprint 3, 5, 11 and Folio 31.

California State Mining Bureau:

Reports of the State Mineralogist, VIII, X, XI, XII XIII, XV, XVII.

Bulletins 92, 85.

IRON.

Chaix Prospect. Sixtie Chaix, Lathrobe via Shingle Springs, has an iron prospect on his property, a mile and a half from Lathrobe in Sec. 14, T. 8 N., R 9 E. According to C. A. Waring, a lens of hematite and magnetite outcrops for a width of 25 feet and a length of 60 feet, but it is very siliceous at the outcrop. No work has been done upon it.

On the *H. Gutenberg Ranch*, five miles east of Diamond Springs, there is a prospect of hematite. It is idle and has not been prospected. Owner, Henry Gutenberg, 2439 Thirty-first street, Sacramento.

Reliance Iron Mine is in Sec. 18, T. 10 N., R. 9 E., eight miles north-east of Folsom. Two veins of magnetite ore, $4\frac{1}{2}$ feet wide, at the granodiorite contact, were worked years ago through three shafts, 50, 218 and 312 feet deep, respectively. It has been idle a long time.

Bibl: Cal. State Min. Bur. Bull. 38, p. 297.

On the *Simons Ranch*, in Sec. 13, T. 8 N., R. 9 E., adjoining the Chaix Prospect, Waring reported iron prospects similar to that on the Chaix place.

LIMESTONE.

Limestone occurs throughout the length of western El Dorado, in the form of lenses in the amphibolite schist and in the rocks of the Calaveras formation, the latter of Carboniferous age. The enclosing rocks usually show schistosity striking northwest and dipping 70° to 85° northeast and the bodies of limestone conform in greatest length and depth with these directions. Several deposits of good grade are being exploited, including the largest quarry in northern California, which supplies limestone for cement manufacture outside the county. Limestone is the largest single item of mineral production in El Dorado County, and is supplied for a great variety of uses.

El Dorado Lime and Minerals Co., J. H. Bell, receiver and superintendent, Shingle Springs. The property is $4\frac{1}{2}$ miles by road southwest of Shingle Springs, and connected with the Placerville branch of the Southern Pacific by 1.9 miles of private narrow-gauge railroad.

The deposit consists of a series of lenses of white and very high-grade limestone which dips east 85° . Two lenses are being worked, the largest of which shows a maximum width of 70 feet underground. The deposit is in a belt of Calaveras (Carboniferous) rocks one-fourth to one-half mile wide, and the two lenses so far opened are separated by a 'horse' of this country rock. Small diabase dikes occasionally cut

across the limestone. The limestone is solid, without gouges on the walls and stands well without timber. A total length of 300 feet along the strike and a width of 115 to 120 feet have been opened, but the probable extent of deposit is not known definitely as it does not outcrop conspicuously and has not been prospected elsewhere.

The limestone is hoisted through a vertical shaft 360 feet deep with levels at 150 and 300 feet. Rock is worked by shrinkage stoping, using benches or slicing and underhand drilling. Drifts 20 feet wide by 8½ feet high are run. The object is to make as much lump rock as possible. Twenty-five per cent dynamite is used. Coarse rock is drilled and blasted in the stopes and again broken by hand with sledges on the grizzlies over the loading pockets at the shaft.

At the shaft collar the stone is run over another grizzly and separated by screening, the finer sizes being crushed as small as 20-mesh. Because of its purity and whiteness, it is in demand for numerous uses. Coarse lumps are sold to the steel mills. It is also used in making paint and kalsomine, and glass. Fine material is sold for agricultural use and chicken grit.

The underground workings at time of visit were an example of first-class mining practice. The plant has a capacity of about 100 tons a day but production fluctuates with the market demand for the product. A total crew of 12 men, of whom 7 were working underground, were employed in September, 1926. Electric power is used for operating the hoist and compressor (each employing 75-h. p. motor) and sizing and crushing equipment. Gasoline locomotives haul the limestone to the Southern Pacific railroad.

The operations at this property were described in detail by George J. Young in 'Engineering and Mining Journal Press,' Vol. 119, No. 25, June 20, 1925, to which excellent article the reader is referred.

Henry Cowell Lime and Cement Company, 2 Market street, San Francisco, owns 885 acres of land in sections 7, 8, 18, and 30, T. 12 N., R. 9 E., on which there is a large deposit of limestone, one-half mile to two miles north of Cool and lying on or near the road to Auburn. This has been mentioned in old reports as the Cave Valley Limestone Quarry, and has also been called the Blue Marble Quarry. Many years ago lime kilns were operated here but nothing has been done recently. Superficially at least, this deposit appears to be as large as the one being operated by Pacific Portland Cement Company, which adjoins on the north, and a quarry face perhaps 200 feet high could be opened by working from the north end.

The same company owns another limestone deposit near Marble Creek three miles east of Clarksville and limestone was burnt there years ago, but it is now idle.

Bibl: State Mineralogist's Report XII, p. 391.

Newcastle Lime Company, Newcastle, has operated intermittently in the past few years at the property described in our past reports under the title of Alabaster Cave Lime Quarry and Farmer Lime Company. The deposit is seven miles by road southeast of Newcastle near Rattlesnake bridge. It is owned by Fred Barkhans of Newcastle and others and contains 36 acres. This quarry was operated by the Holmes Lime Company for 27 years and lime was burned. During recent years

grinding machinery has been installed and crushed and ground stone produced during part of the year, and lime from the kilns at other seasons.

The limestone occurs as a large upright lens of good grade, gray in color. It has been opened by a quarry on a level a little above the mill and kilns, and is hand trammed from the pit to the plant, a distance of a few hundred feet. For grinding, it is hand fed to a Dodge crusher which breaks to one inch, and then goes over a short belt-conveyer to a Beers roller-mill which crushes to one-eighth inch. The grinding plant has a capacity of 20 tons daily and the ground product is used for a soil corrective and fertilizer. Electric power is used. For burning lime there are three upright oil-fired kilns with a capacity of 150 tons a month each. Lime is sold to cyanide plants, for fruit-tree spraying and for fertilizer locally, besides occasional shipment by rail from Newcastle, which is the nearest railroad point. Four to seven men are employed when operating.

Pacific Portland Cement Company operates two miles north of Cool, the largest limestone quarry in northern California. The property is on the side of the canyon just south of the Middle Fork of American River and is connected by seven miles of broad gauge railroad with the main line of the Southern Pacific at Flint, one mile west of Auburn.

The limestone deposit is a lens about one mile long, north and south with the river crossing it, about two-thirds of the outcrop being on the El Dorado County side and one-third in Placer County. It stands nearly vertical in amphibolite schist and is said to be of Carboniferous age. Diamond drilling proved it to a depth of 800 feet, of which about 600 feet stands above the river level, according to the U. S. Geological Survey contour map. It is 300 to 400 feet wide.

The quarry is being worked through an adit 70 feet above the river, 10 feet high by 14 feet wide and now about 1800 feet long. Raises were put up from the adit level and glory holes opened from them after clearing the overburden with a steam shovel. Three large pits have been worked in this way, dumping the stone down the raises to the 6-ton cars at the adit level, from which it is hauled to the crushers and sizing plant. Most of the limestone is shipped to the company's plant at Cement, Solano County, for making Portland cement, but coarser sizes are sold to smelters and sugar refineries. This operation employs about 140 men in all departments. The quarry was opened in 1910, and most of the time since it came into full production is said to have turned out 1200 to 1500 tons of limestone a day, forming the principal source of supply for the cement plant mentioned.

The operations were described in detail by George J. Young in 'Engineering and Mining Journal Press,' July 4, 1925, to which article the reader should refer for further information.

Sierra Lime Company. S. Hornstein, 1000 Forty-fifth street, A. F. Grant, C. J. Eastman and J. Dunasky, P.O. Box 189, Sacramento, are interested in this project. Two lime kilns at Diamond Springs station have been repaired. A limestone quarry in the SE $\frac{1}{4}$ of NE $\frac{1}{4}$ of Sec. 28, T. 10 N., R. 11 E., four miles by road east of the kilns, has been leased and prospect work indicates a deposit about 75 feet deep and of sufficient volume to supply the kilns for a long time. It outcrops for a

length of 1200 feet and lies at an elevation of 2000 feet. Various colors occur and the stone is of good quality according to analyses.

The kilns have a total daily capacity of 16 tons. Slab wood from a nearby lumber mill will be used for fuel, allowing a big saving on this item. The company is now seeking additional finances to continue work.

Besides the above, the following have been mentioned as containing marble, but have not made any production of marble so far as known:

Bind & Company Deposit, two miles south of Placerville on Webber Creek. Idle.

Bibl: State Mineralogist's Reports XII, p. 391; XIII, p. 628.

Indian Diggings Marble Deposit, in Sec. 18, T. 8 N., R. 13 E., at Indian Diggings. Owned by Hayward, Hobart & Lane Estates, 1128 Merchants' Exchange Building, San Francisco. It is remote from the railroad. Idle.

Swisler Deposit is five miles southeast of Placerville. Idle. It was once the site of several lime kilns.

Bibl: State Mineralogist's Report XIII, p. 638.

MINERAL PAINT.

Samples of both red and yellow ocher have been brought to the attention of the State Mining Bureau from different parts of the county. The deposits have not been visited, as several of them are remote from railroad. The following parties have submitted material which, judged by the quality of the small samples sent in, might be suitable for mineral paint if in sufficient quantity and not too far from railroad. The exact localities from which samples came were not given.

George Bilstead, Georgetown. Yellow ocher.

Ambrose Hoefling, Motor Route A, Box 1010, Sacramento. Samples from near Slate Mountain, which is 12 miles or more northeast of Placerville.

F. B. Norton, Greenwood. Yellow ocher. Greenwood is 13 miles from Auburn, the nearest railroad station.

Mrs. H. Waters, 1336 Adeline street, Oakland. Yellow ocher from the vicinity of Cool, which is seven miles from Auburn by road.

MINERAL SPRINGS.

Glen Alpine Springs are seven miles southwest of Tallac, which is at the south end of Lake Tahoe. The water of the two springs is cold, strongly carbonated and carries some iron. The property has been used as a summer resort for many years. Elevation 6850 feet.

Bibl: U. S. Geol. Survey, W. S. P. 338, pp. 236, 373.

Rubicon Springs are on Rubicon River, 12 miles west of Lake Tahoe by road. Like Glen Alpine Springs, the water of the three springs here is cold, strongly carbonated and contains iron. The place has been a summer resort from early days. Elevation 6060 feet.

Bibl: U. S. Geol. Survey, W. S. P. 338, pp. 234, 373.

Wentworth Springs are eight miles by road west of Rubicon Springs and are reached also by road from Georgetown on the southwest. There are 14 small springs or seepages of mineral water here. The water is cool and carbonated and carries sodium, calcium, magnesium and some hydrogen sulphide. There are no accommodations, but many campers go there in summer. Elevation 6000 feet.

Bibl: U. S. Geol. Survey, W. S. P. 338, pp. 235, 373.

There are unnamed sulphur springs in the canyon of Rubicon River at three places 13, 14 and 16 miles southwest of Lake Tahoe. There is also a small sulphur spring near Kyburz, on the Placerville-Lake Tahoe highway.

QUICKSILVER.

Bernard Cinnabar Mine. (Amador Cinnabar) contains 10 acres in NE $\frac{1}{4}$ Sec. 4, T. 8 N., R. 10 E., on Fanny Creek two miles west of Nashville. The nearest railroad station is Shingle Springs, eight miles north by road. Owner, Bernard Cinnabar Mining Company, care J. Ruset, 211 Steiner Street, San Francisco.

Cinnabar is said to occur with pyrite as a filling of the interstitial spaces in the slaty and quartzitic schist of the Calaveras (Carboniferous) rocks for a width of 20 to 50 feet. Some mercury was produced in the '60's. Although reopened twice since, in 1903 and 1917, there is no later record of production. There is an old shaft 75 feet deep and some short adits.

Bibl: State Mineralogist's Report XII, p. 359; Bull. 78, p. 42.

U. S. Geol. Survey, Folio Reprint 3, 5, 11.

Traces of cinnabar have been noted five miles south of Shingle Springs and at one or two other points, but were evidently of little promise at the surface, as they have not been developed.

SILICA.

Brandon Silica Deposit. Chas. Brandon, owner, Shingle Springs. A quartz vein 10 to 35 feet wide outcrops for a length of about 250 feet, on the ranch property a mile and a half from Flonellis spur on the Placerville branch of the Southern Pacific Company. There is an old private road directly to the deposit from the county road, and backs of possibly 40 to 50 feet could be obtained above the road level on the north end of outcrop. The quartz is white but shows a few small flakes of included country rock and some iron stains.

Quartz cobbles have been shipped in past years from the *Coon Hollow* diggings, a mile south of Placerville. There is no production at present.

Snow Silica Deposit. Jacob Snow, owner, Motor Route A., Box 44, Placerville.

A large vein of massive white quartz outcrops just east of where the Placerville and Mosquito road crosses White Rock Canyon $4\frac{1}{2}$ miles northeast of Placerville. The vein strikes northwest and is exposed for at least 600 feet along the strike. Where exposed by workings 20 feet deep or less, over a length of 150 feet it has a width of 25 feet on the surface, the apparent width being much greater because of erosion and the exact width somewhat less, measured at a right angle to the dip.

The sections next the walls are slightly iron stained from the reddish oxide in the decomposed wall rocks, but the quartz itself is remarkably pure and in the central part of vein is perfectly white with some small crystals.

The deposit is within a few feet of the county road and on the ridge at sufficient height to give backs for working a large tonnage by tunnel and glory hole or by open-cut. The elevation is 2050 feet. Several carloads of silica were produced in 1919, and some in 1925.

One-half mile northwest of the above, and reached by a short private road, is another large outcrop of pure white quartz, exposed on the surface for a width of 40 to 100 feet and a length of 160 feet, but the exact width is not known as no mining has been done upon it. In October, 1926, a few tons of the surface of outcrop were broken up and hauled out for use. A high tension electric power line passes within one-fourth mile of this deposit. Idle, and ownership unknown.

Pure silica is used in making glass, for glazes in porcelain and pottery, and to diminish shrinkage in pottery, fire-brick, etc., for abrasives, filler in paint and soap, for sodium silicate and foundry flux. The chief competitor of the Californian silica is the Belgian sand which is mined in large quantities by cheap labor, is so nearly pure as to be sold without any expense for preparation, and is imported in ballast in ships coming here for return loads, at a very low total cost. Certain users who mined sand here during the war, when importations from abroad were shut off, have returned since to the use of Belgian sand. For certain purposes the crushed vein quartz is better than the natural sand although the cost of crushing and grinding to a fine mesh size is considerable.

SLATE.

The black clay slate of the Mariposa beds extends across the western part of the county from north to south from the Middle Fork of American River northwest of Georgetown, past Kelsey, Placerville and Nashville. The width of the formation varies from one to three miles. The black slate contains the principal gold quartz veins of the Mother Lode. Compared with the harder and stronger rocks on both sides, the slate forms a structurally weak belt, and has been the locus of repeated pressure and faulting, continuing over long periods of time. First class roofing slate has been produced from the Mariposa beds at different quarries between Placerville and Kelsey, from one to eight miles from the railroad. Sawed slate was also produced at Kelsey. The slate is of a good blue-black color, good strength and does not fade appreciably nor soften after many years exposure, judging by roofs and sides of buildings that must have been built at least 25 years, and many of them longer. Only one quarry is being operated at present.

Slate, properly laid, forms a permanent roof and is especially desirable for public and other large buildings built for a long life, and high-class residences. Californian slate has been used in years past, but more recently has been unobtainable as no quarries have been in operation. It is probable that a good quarry, operated by experienced slate makers without excessive outlay for unessential machinery or overhead expense could have built up a good business in roofing slate during the past five years. However, as conditions have been, with no steady source of supply available, the person desiring to use a slate

roof has been compelled to go to eastern and even foreign (Belgian) producers. The freight charge alone on such slate gives the Californian product a great advantage and the quality of the local slate has been shown to equal that brought from the eastern states.

Slate is also used for blackboards and school slates, interior uses of a great variety including sinks, table tops, tiling, steps, mantels, etc.,



Splitting roofing slate at a quarry near Placerville.

and electric switchboards. Waste slate has a constantly increasing field of use under favorable conditions as a filler, for which it must be ground as fine as those products it is intended to replace. It is used in making plastic flooring, and other plastic products. Crushed slate is also used for coating prepared roofing and shingles.

Buck Slate Quarry adjoins Chili Bar Quarry and was opened about the same time, but apparently was operated only a short time.

Bibl: State Mineralogist's Report VIII, p. 200.

California Bangor Slate Co. Address Judge C. E. Robinson, Court House, Oakland. Property contains 432 acres in Secs. 3, 10, 11 and 14, T. 11 N., R. 10 E., covering over two miles along the strike of black slate, beginning a mile west of Kelsey, and on the north of Eureka Quarry. There has been no activity for a great many years.

Bibl: State Mineralogist's Report XV, p. 306.

California Slate Quarry was between Kelsey and the South Fork of American River, in Secs. 23 and 25, T. 11 N., R. 10 E. The workings are reported to have opened a poor quality of slate, carrying considerable pyrite. No work has been done for nearly 25 years.

Bibl: State Mineralogist's Report XV, p. 306; Cal. State Min. Bur. Bull. 38, p. 150.

Chili Bar Quarry is on the South Fork of American River just west of Chili Bar bridge and $3\frac{1}{4}$ miles north of Placerville on the Kelsey road. It was opened in 1887 and employed 10 to 16 men intermittently until 1897, since which time it has remained idle, due perhaps to encountering poor material in the quarry.

Bibl: State Mineralogist's Reports VIII, p. 199; XIII, p. 639; XV, p. 306. Cal. State Min. Bur. Bull. 38, p. 150.

El Dorado Slate Company, care George Appell, Humboldt Bank Building, San Francisco, owns 13 acres in Secs. 6, 7, T. 10 N., R. 11 E.

El Dorado Slate Products Company is a California corporation formed in 1923 to work the old Chadbourne slate quarry on the south side of Big Canyon, a mile and a half north of Placerville station by road. They own 32 acres, mostly patented, and have their office at the property.

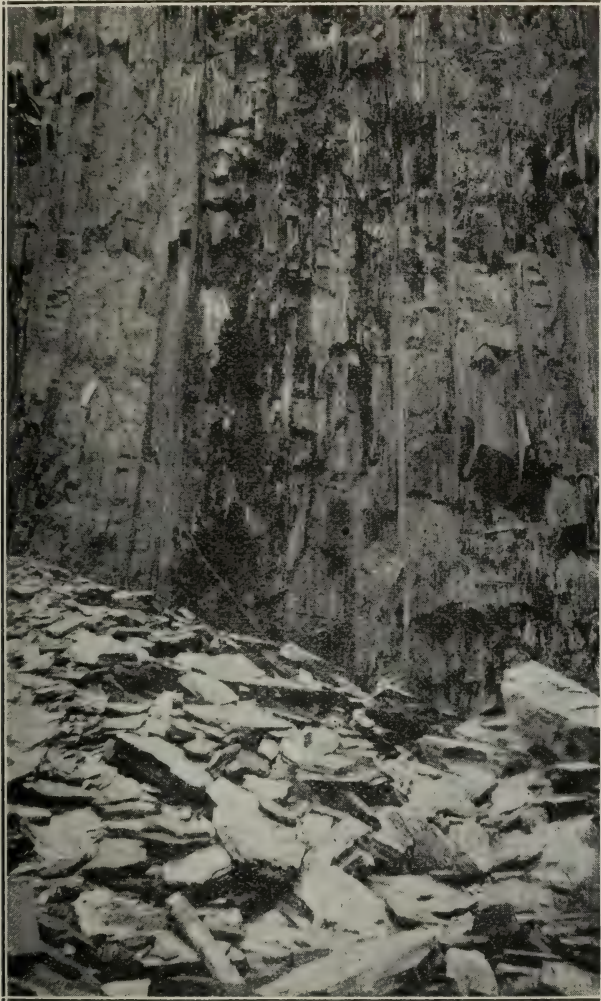
Several small quarry faces were started years ago by those who made abortive attempts to operate the property. One pit is 175 feet below the top of the hill and another at the creek level 125 feet lower, but not enough work was done to develop fresh, clean slate beds. The slate has the usual steep easterly dip of the Mariposa formation and in the upper pit a width of 22 feet is free from quartz seams and pyrite so far as could be seen in the limited space opened. The present company is enlarging this working.

An overhead cable span 1200 feet long is anchored on the north side of Big Canyon and a hoist installed on the south side on top of the hill raises the slate to be marketed, and is used for handling heavy blocks of slate in quarry. The hoist, air compressor, electric motors and shop are housed in a new building. The beds of slate so far are narrow, but it is believed will thicken as soon as the quarry face is carried far enough to get into fresh slate and away from the crushed and sliding area existing near the surface because of the steepness of the slope.

Four men are employed in the quarry (October, 1926) and three on top, one expert slate splitter being employed. A stock of roofing slate is being built up slowly as the proportion of slate fit for splitting is

small just at present. Waste slate is being shipped to a firm making slate covered asbestos shingles, for which use it is crushed rather fine.

Eureka Slate Quarry, a mile from Kelsey and eight miles by road from Placerville was operated on a large scale and furnished roofing slate for many buildings on the Pacific coast but has lain idle for ten years past. When last worked it was equipped with quarrying machin-



Face of slate in quarry of El Dorado Slate Products Co.,
near Placerville.

ery, five hoisting engines, air compressors, slate saws, planers, and other equipment for extensive and varied production, and most of the machinery is still on hand. An aerial tramway 13,000 feet long from the quarry to Placerville is falling to ruin. The quarry had a capacity of 1000 squares a month.

This is a large property and is said to still contain a great deal of good slate. Poor management, extravagance and reverses in other lines

of business suffered by those in charge are thought to have caused the closing of it. The nominal owner is Sierra Slate Company, 4 and 6 White Street, New York, but a mortgage is held by the Easton Bank, Easton, Pennsylvania.

There was found within the black slate beds in this quarry, a greenish gray dike evidently of igneous origin, which had been pressed and rendered slaty in structure to such an extent that it could be quarried and worked up into good roofing slate.

Following is an analysis of the Eureka quarry's black slate, from our Bulletin 38:

Silica (SiO_2)	63.52%
Alumina (Al_2O_3 & TiO_2)	16.34%
Iron oxides (FeO , Fe_2O_3)	6.79%
Lime (CaO)	.98%
Magnesia (MgO)	2.50%
Carbon dioxide and water	4.86%

On the *Gentle Annie Quartz Mine* in Sec. 6, T. 10 N., R. 11 E., a mile north of Placerville, an adit run years ago was reported to have passed through a belt of black slate 97 feet wide at a depth of 250 feet, which was thought to be a continuation of that in the Chili Bar Quarry. No work was done to develop it.

George M. Clark, Placerville, is the owner.

Bibl: State Mineralogist's Report XII, p. 401.

Losh Slate Quarry contains 18 acres, unpatented, on the Kelsey road four miles north of Placerville and one-half mile from Chili Bar bridge over the South Fork of American River. It covers 1250 feet along the strike of the slate beds. There was some production 30 years ago from the pit beside the road. Frank A. Losh is the owner.

Losh began work in August, 1921, and worked until December, then resumed work in May, 1922, and worked until the end of 1924, since when only assessment work has been done. The splitting of roofing slate started with little delay, as good slate was found in the old pit with little dead work required. Later, however, the slate is said to have shown so many joints that prospecting will be required to open new beds. Various sizes of roofing slate from 6 inches by 12 inches to 12 inches by 24 inches were made and the quality was good. There is no equipment at the quarry. The pit, which is 50 feet deep, 40 feet wide and 40 feet long, is on a steep hillside with plenty of room for dumping waste and good drainage, so that operating conditions are favorable.

SOAPSTONE.

Sawed soapstone slabs and blocks were shipped over 40 years ago from one property in this county, and for several years recently 'off-color' soapstone was mined and shipped from Shingle Springs and adjacent districts near the railroad, but no production is going on at present. Recently productive properties were mentioned in the Seventeenth Report of the State Mineralogist, 1920. Most of it is greenish gray in color, gray when ground, and is found in the form of lenses associated with serpentine. In late years it has been used mostly for coating prepared roofing, for which purpose the color is less important than freedom from iron or excessive grit.

The uses of tale and soapstone are numerous, falling into several classes, such as filler for rubber, cloth, paint and paper; lubricants and electric insulation, for which uses it is ground fine; and block or slab soapstone which is used for tubs, sinks, chemical tanks, switchboards, griddles, fireless cooker stoves and the like.

Brandon Deposit. (See Victor S. Richardson.)

Darlington Soapstone Deposit was probably the first one worked in the county, having been operated more than 40 years ago when sawed slabs and blocks were produced and shipped from Shingle Springs as the railroad had not been completed to Placerville at the time. The deposit is on the Darlington Ranch, three miles by road southeast of Placerville, near Webber Creek, at an elevation of 1680 feet.

In an old pit on top of a hill north of the creek good quality massive soapstone outcrops for a width of six feet, with an equal width badly stained by iron oxide. Adjoining this on the west is an additional width of 25 feet outcropping, of which 22 feet is off-color soapstone, so far undeveloped. The work done was evidently near the north end of a lens which strikes northwest and outcrops for a length of 130 feet. It occurs in the Calaveras schist formation.

H. Gutenberger, 2439 Thirty-first street, Sacramento, has ranch property on the Pleasant Valley road five miles from Diamond Springs, where he reports the occurrence of large outcrops of 'off-color' soapstone, similar in quality to that which has been mined near Shingle Springs. It has not yet been developed.

E. B. Harold, Rescue, has an undeveloped deposit of soapstone four miles from Shingle Springs, which is a railroad shipping point.

Victor S. Richardson, Shingle Springs, has a deposit of soapstone 300 yards from Brandon spur on the Placerville branch of the Southern Pacific Company. It has been prospected a little by short tunnels but only one car of soapstone has been shipped yet. It is 'off-color' for the most part, of grade similar to that shipped elsewhere for roofing, but some of it is of higher quality. There is the possibility of developing a good-sized deposit here, as the prospecting work advances into the hill. The soapstone is associated with serpentine. Idle.

Rossi Soapstone Company in 1924-25 operated the deposit described in our Seventeenth Report, under the title of Shingle Springs Soapstone Deposit, but is idle at present. This soapstone is a mile east of Shingle Springs station and occurs in the form of a lens associated with serpentine. It was 'off-color' when ground and was used for coating ready roofing.

Bibl: State Mineralogist's Report XVII, p. 432.

Swift Soapstone Mine at Swift spur on the Southern Pacific Railroad west of Shingle Springs was worked for several years by the owner, C. S. Swift of Latrobe. It was so close to the railroad tracks that the stone could be hand trammed from the mine and dumped directly into the railroad cars. The workings caved some time ago and the property has been idle since. The soapstone was used by makers of ready roofing.

Bibl: State Mineralogist's Report XVII, p. 432.

VOLCANIC ASH.

The most accessible deposits of volcanic ash in the county are those overlying the ancient channels at Placerville and Smith's Flat. It is white to gray in color when dry and is somewhat coarse grained. A soft, fine-grained volcanic ash occurs north of Young's (Pleasant Valley). This material is rhyolite tuff and in places is overlain by later volcanic material. Some of the tuff is massive and has been used in the past for buildings.

Carpenter Mine. Bert Carpenter, owner, Smith's Flat. It adjoins the town of Smith's Flat, three miles from Placerville on the Lake Tahoe highway. A deposit of volcanic ash overlies the gravel. Idle.

Selah Chamberlain, 850 Mills Building, San Francisco, owns land near Smith's Flat where a streak of volcanic ash four feet thick, overlain by soil, has been cut.

J. L. Gibson, Young's P. O., brought into the State Mining Bureau samples of good grade, fine grained, soft volcanic ash, said to occur northwest of Pleasant Valley, about 10 miles east of Diamond Springs.

Mierson Deposit. Owners, Max Mierson and Oscar Reeg, Placerville. It is $2\frac{1}{2}$ miles east of Placerville, near the state highway. There is said to be a thickness of 20 feet of volcanic ash free from iron oxide stains, as exposed in an old adit 100 feet long.

SAN FRANCISCO FIELD DIVISION.

C. MCK. LAIZURE, Mining Engineer.

On account of unfinished field work, there is no report from the San Francisco Field Division in this issue.



LOS ANGELES FIELD DIVISION.

W. BURLING TUCKER, Mining Engineer.

INYO COUNTY.

Introduction.

The field work in this report was carried on at intervals from June until November, 1926.

The writer devoted most of his attention to the mines in operation throughout the county, but also devoted some attention to obtaining reliable information concerning the many prospects and claims that hold considerable promise. Much time was also devoted to the non-metallic deposits of the county.

Location and Description.

Inyo County lies along the eastern border of California and is bounded on the north by Mono County, on the south by San Bernardino County and on the east by Fresno and Tulare counties. The county has an area of 10,224 square miles, being the second largest county in California.

Independence is the county seat, while Bishop, with about 2000 inhabitants, at present is the center of population. The other towns of importance are Keeler, Lone Pine and Big Pine.

Within the borders of the county are both the highest point and the lowest point in the United States. Mount Whitney has an elevation of 14,501 feet, while the lowest point in Death Valley, at Salt Flat, is 280 feet below sea level.

The Sierra Nevada range forms the west wall of Owens Valley, and the main divide of the Sierra Nevada forms the western boundary of the county. It ranges from 11,000 to 14,500 feet in height, Mount Whitney being 14,501 feet and the next highest peak, Mount Williamson, 14,384 feet. The Inyo Range is the first range of mountains east of the Sierra Nevada. Between these two ranges lies the deep depression known as Owens Valley, at whose south end is Owens Lake. The floor of Owens Valley is from two to eight miles wide. The floor, which is very even, slopes southward at the rate of seven feet to the mile, from 8000 feet above sea level at the north end to 3600 feet at Keeler, on Owens Lake. The Inyo and White mountains form the east wall of Owens Valley. The range trends northwestward, on the south being separated from the Coso Mountains by a broad depression, and on the north terminating in Mount Montgomery. The average elevation of the range is 10,000 feet. The eastern border of this range is not sharply marked. In its northern part it is marked by Fish Valley, but between this valley and Saline Valley, to the south, there is an irregular mountainous area that is not clearly separated from the Inyo Range nor the ranges on the east. Still farther south, the deep elliptical depression known as Saline Valley, whose floor is 2500 feet lower than that of Owens Valley, separates the Inyo Range from the Ubehebe Range on the east.

In the northeastern portion of the county, Eureka Valley is located between the White Mountains and the Last Chance Range.

Panamint Valley, which is located between the Coso Mountains on the west and the Panamint range of mountains on the east, extends in a northwesterly direction from the southern boundary line of the county for a distance of about 45 miles, and is from two to ten miles in width. The Panamint range of mountains extends from the southern boundary line of the county in a northerly direction, a distance of approximately 75 miles, where it connects the Last Chance and Ubehebe mountains. The highest point of this range is Telescope Peak, with an elevation of 11,045 feet, located north of the camp of Panamint. The Panamint range of mountains forms the western boundary of Death Valley, while on the eastern limit of the valley is the Amargosa Range, which is made up of the Grapevine, Funeral and Black mountains. Death Valley extends northwesterly from the southern boundary of the county, a distance of about 90 miles, to where it runs into Lost Valley. The floor of Death Valley is from five to ten miles wide.

Climate.

Because of the great range in the altitude of the region, the climate in different parts of it is very diverse. In general, the climate is typical of the southern half of the Great Basin, of which it is a part. In Owens Valley the summer temperature often exceeds 100°, yet, owing to the low humidity, it does not become oppressive; but in the deep depressions that are encircled by high mountains, such as Saline, Panamint and Death Valley, the temperature is oppressively hot from June to October, without intermission day or night. The winters are comparatively mild in the valleys.

The average precipitation ranges from 3 inches a year at Owens River to 40 inches on the Sierra Nevada crest. The moisture-laden winds from the Pacific Ocean are largely robbed of their moisture before reaching the Inyo and other ranges of mountains to the east. Sufficient snow falls on the higher peaks of the mountains east of the Sierra Nevada to support several small perennial streams. The whole region, however, is subject to electrical storms which often cause temporary local floods.

Drainage and Water Supply.

The principal streams of the region are the Owens River and the Amargosa River. Owens River rises in the Sierra Nevada Mountains near San Joaquin Pass, and enters Owens Valley north of Bishop, then meanders through Owens Valley southwestward toward Owens Lake. Practically all its tributaries enter from the west, and are fed almost wholly by snows that accumulate just east of the main Sierra Divide. The water of Owens River is now used for the Los Angeles aqueduct. The intake of the aqueduct is 13 miles north of Independence; this main canal has a capacity of over 800 cubic feet per second, and a width of 65 feet on the bottom. It diverts the river and various tributaries as they are passed, discharging into the Haiwee reservoir 60 miles below the intake. The Haiwee reservoir has a capacity of 63,800 acre-feet.

The Amargosa River rises in springs north of Beatty, Nevada, and flows southward, intermittently, across the Amargosa Desert, and through Franklin Lake to Resting Springs Lake. It enters a narrow

canyon south of Tecopa, between the Black and Kingston mountains, and there spreads out, forming a great dry wash, where it is joined by the South Amargosa, which rises in Silurian Lake. The river takes a broad turn to the westward around the south end of Black Mountain, and enters Death Valley flowing northwestward in the region of Saratoga Springs. The head waters of the Amargosa are fine and fresh, but become briny with salt, borax and niter in the region of Resting Springs, Dry Lake, and leaves salt patches along its course all the way into Death Valley.

On the east side of Death Valley several springs, such as Furnace Creek and Grapevine springs, furnish a constant water supply. On the west side of the valley, water is found at Blackwater Spring, Death Valley Cañon, Hanaupah Cañon, Hungry Bill's Ranch, Arrastra Springs and Anvil Springs. In the Panamint Valley drainage all large canyons on both sides contain springs or small living streams.

On the east side, from north to south, there are Mysterious Canyon, Wild Rose Canyon, Tuber Canyon, Jail Canyon, Hall Canyon, Middle Canyon and South Park Canyon. On the west side, from north to south, there are Mill Creek, Darwin Canyon, Wash Canyon, Modoc Canyon, Snow Canyon, Wood Canyon, Knights Canyon, Revenue Canyon, Shepherd Canyon and Water Canyon.

In the Searles Lake drainage there are a number of small springs in the Coso Mountains, these with wells, are used for water supply for the mines and the works at Trona. In the extreme southeast portion of the county, there are some wells and springs along the Amargosa River and in the Kingston Mountains.

Railroads.

Two railroads enter the county, the Southern Pacific and the Tonopah and Tidewater. The Nevada and California, a narrow gauge line, now a part of the Southern Pacific system, passes along the east side of Owens Valley. It connects with the Tonopah branch at Mina, Nevada, and its southern terminus is at Keeler, on Owens Lake. The broad gauge branch of the Southern Pacific runs from Mojave to Owenyo, where it connects with the narrow gauge line from Keeler. The Tonopah and Tidewater railroad, which follows the Amargosa River through the extreme eastern part of the county, serves with spur tracks the Tecopa lead-silver mines, Furnace Creek borax mines, and the mining districts near the California-Nevada boundary line.

Roads and Routes.

In recent years the roads of the county have been greatly improved, making travel by automobile over the different routes comparatively easy.

The different routes are as follows:

1. The main highway route from Los Angeles, via Mojave to Bishop, enters the county south of Little Lake and runs through Owens Valley to Bishop. This road is maintained by the California State Highway Commission.

2. The Midland Trail, or Deep Springs Valley toll road, starts from Big Pine and Alvord and passes through Payson Cañon, Deep Springs Valley, Oasis, Palmetto and Lida to Goldfield.

3. A new route that has been completed during the last year is known as the Eichbaum toll road and runs from Lone Pine and passes through Keeler, Darwin and down the Darwin Wash, across Panamint Valley and through Townsend Pass to Stove Pipe Wells, in Death Valley, from which it crosses the Amargosa Range to Beatty, Nevada. The Ballarat-Trona road branches off from this road in Panamint Valley.

4. The Big Pine and Saline Valley road leaves Big Pine and Alvord and passes through Waucoba Cañon and down Marble Canyon and Saline Valley. At present this road is hardly passable between Marble Canyon and Saline Valley, due to washouts.

5. Another route to Saline Valley from Lone Pine passes through Keeler and over Darwin-Keeler road to Lee Flats, following northward a canyon which lies east of the Inyo range of mountains.

6. The Waucoba Cañon-Eureka Valley road is passable only as far as the Loretta Mine.

General Geology.

The general geology of the county has been described in detail in Report XV of the State Mineralogist, pp. 45 to 60, and a geological map of Inyo County accompanies that report. Copies of the map are separately available.

The east slope of the Sierra Nevada is a great fault escarpment. It attains its greatest and most abrupt relief west of Owens Valley, rising from 3600 feet on Owens Lake to 14,500 feet on Mount Whitney. The escarpment of the Sierra Nevada is composed of granitic rocks. Granite forms the backbone of the Inyo and White mountains and of the Panamint Range. East of Owens Valley, old Paleozoic metamorphic sediments, consisting of limestone, quartzites, and schists make up most of the mountain ranges. These are extremely folded and faulted, due principally to granitic intrusions. Overlying the Paleozoic metamorphics of the Inyo Mountains, in places, is an unconformable series of Mesozoic metamorphic rocks consisting of crystalline limestone and slates, which in places are fossiliferous. The post-Jurassic (middle Mesozoic) uplift in this region was accompanied by granitic intrusions and the great fault along the east face of the Sierras; also by mountain-making to the eastward, at which time, or following, the Inyo, White, Panamint and Amargosa mountain ranges were formed more or less parallel to the fault line. Intrusions of porphyry and diorite followed, with outbursts of rhyolite, andesite and basalt. A large area of vulcanism was formed in the Coso Mountains, and lava broke out along fractures on both sides of Death Valley and eastward. Molten rock also flowed from the main fault along the Sierras, eastward across Owens Valley south of Big Pine and north of Bishop. In the meantime, early Tertiary sediments were being deposited in the Death Valley region, and saline deposits were forming from the evaporating sea waters.

Smaller uplifts and earth movements took place during the readjustment of the cooling mass, and Pleistocene lake deposits were laid down in several of the large inclosed basins, such as in the lower Amargosa and Waucoba cañons.

Power.

Electric power, generated in the Sierras west of Bishop, is available in the northern and western parts of the county. The eastern, south-eastern and central portions of the county are dependent on internal combustion engines.

Two power companies have hydro-electric plants on Bishop Creek. The Nevada-California Power Company, owning three plants, confines its operations exclusively to the state of Nevada.

The Southern Sierras Power Company has two hydro-electric plants on Bishop Creek. Its lines extend from the plants on Bishop Creek down the Owens Valley, with a branch to Keeler; to Big Pine and to Palmetto, Nevada.

The city of Los Angeles (Bureau of Power and Light) operates a hydro-electric plant located on Cottonwood Creek, with a capacity of 2100 horsepower.

Mineral Resources.

The principal mineral resources of the county are antimony, asbestos, barytes, borates, copper, dolomite, gems, gold, gypsum, lead, marble, pumice, soda, sulphur, talc, tungsten and zinc. Deposits of iron, molybdenum, niter, potash, quicksilver and silica occur but have not been developed.

The following table shows the mineral production from the year 1880 to 1925, inclusive, and the development of the mining industry:

INYO COUNTY,

Year	Gold, value	Silver, value	Lead		Copper		Zinc		Borax, value
			Pounds	Value	Pounds	Value	Pounds	Value	
1880.....	\$48,648	\$173,916	-----	-----	-----	-----	-----	-----	-----
1881.....	170,000	140,000	-----	-----	-----	-----	-----	-----	-----
1882.....	220,000	130,000	-----	-----	-----	-----	-----	-----	-----
1883.....	90,000	38,000	-----	-----	-----	-----	-----	-----	-----
1884.....	80,000	82,000	-----	-----	-----	-----	-----	-----	-----
1885.....	24,998	73,461	-----	-----	-----	-----	-----	-----	-----
1886.....	20,156	101,670	-----	-----	-----	-----	-----	-----	-----
1887.....	10,649	103,370	-----	-----	-----	-----	-----	-----	-----
1888.....	25,000	75,000	-----	-----	-----	-----	-----	-----	-----
1889.....	193,957	30,706	-----	-----	-----	-----	-----	-----	-----
1890.....	62,432	88,320	-----	-----	-----	-----	-----	-----	-----
1891.....	35,466	112,730	-----	-----	-----	-----	-----	-----	-----
1892.....	13,930	35,995	-----	-----	-----	-----	-----	-----	-----
1893.....	25,945	52,475	-----	-----	-----	-----	-----	-----	-----
1894.....	52,639	83,640	900,000	\$27,000	-----	-----	-----	-----	\$81,298
1895.....	92,142	188,329	1,498,000	46,438	-----	-----	-----	-----	40,000
1896.....	238,507	108,619	1,220,000	36,600	-----	-----	-----	-----	24,900
1897.....	159,840	50,063	564,000	19,176	-----	-----	-----	-----	-----
1898.....	137,107	73,503	580,000	21,170	49,829	\$3,986	-----	-----	33,000
1899.....	114,187	57,529	662,000	28,135	-----	-----	-----	-----	24,000
1900.....	213,655	113,483	971,000	38,840	-----	-----	-----	-----	13,901
1901.....	162,406	56,573	601,000	24,040	8,566	1,349	-----	-----	24,250
1902.....	74,397	14,484	257,500	9,013	1,100	126	-----	-----	36,394
1903.....	66,045	18,200	95,000	3,420	23,450	3,098	-----	-----	26,400
1904.....	150,474	7,122	124,000	5,270	25,508	3,252	-----	-----	-----
1905.....	135,959	29,741	345,680	16,247	151,606	23,649	-----	-----	-----
1906.....	19,449	13,358	208,018	11,857	4,145	800	-----	-----	-----
1907.....	57,241	44,440	261,140	13,096	6,779	1,356	144,213	\$8,598	*
1908.....	308,873	30,900	683,401	28,244	6,820	938	-----	-----	*
1909.....	457,486	47,117	2,364,137	131,199	39,888	5,073	-----	-----	*
1910.....	408,509	129,590	2,866,227	127,385	58,801	7,489	-----	-----	*
1911.....	574,945	45,678	1,182,122	53,195	27,889	3,486	*	-----	*
1912.....	369,758	45,316	1,207,593	54,342	48,584	8,016	*	-----	*
1913.....	237,310	136,854	3,322,308	146,182	113,860	17,648	*7,149,523	449,701	*
1914.....	275,000	255,000	4,626,934	180,450	336,423	44,744	399,641	20,381	*
1915.....	317,905	127,894	4,323,639	203,211	154,722	27,076	4,625,162	573,520	*8,162,727
1916.....	131,722	232,441	11,185,321	771,787	274,032	67,412	5,758,703	771,666	1
1917.....	125,394	534,599	19,318,642	1,661,403	175,273	47,850	3,525,000	359,550	1
1918.....	100,240	441,548	12,223,471	867,866	338,518	83,614	2,517,045	229,051	1
1919.....	69,560	194,151	3,643,485	193,105	169,713	31,567	1,192,353	87,042	1
1920.....	55,634	258,929	4,612,338	368,987	144,286	26,549	1	-----	-----
1921.....	80,373	86,020	1,052,253	47,351	45,725	5,898	-----	-----	-----

*Combined to conceal individual annual output.

1See under 'Unapportioned'.

INYO COUNTY.

Year	Gold, value	Silver, value	Lead		Copper		Zinc		Borax, value
			Pounds	Value	Pounds	Value	Pounds	Value	
1922	\$85,265	\$256,009	6,264,138	\$344,528	69,537	\$9,388	¹	-----	¹
1923	36,702	265,023	9,541,868	667,931	77,349	11,370	-----	-----	¹
1924	19,977	115,799	4,813,718	385,098	79,995	10,479	-----	-----	¹
1925	43,774	117,763	6,307,105	548,196	73,003	10,367	145,000	\$11,020	¹
Totals	\$6,394,016	\$5,417,368	107,826,038	\$7,081,672	2,405,401	\$456,580	125,456,640	\$2,510,529	\$8,466,870

* Combined to conceal individual annual output.

¹ See under 'Unapportioned'.

1880-1925.—Continued.

Soda		Soapstone and Talc		Marble		Miscellaneous and unapportioned		
Tons	Value	Tons	Value	Cu. ft.	Value	Amount	Value	Substance
1		1		1		43,778 tons 12,000 1,358,207	\$72,284 12,000 1,358,207	Dolomite. Miscellaneous stone. Borates, building stone, clay (pottery), fuller's earth, limestone, marble, pumice, soda, talc, zinc.
24,116	\$662,747	5,981	\$104,976	1		47,542 tons 79,793 19,500 997,539	79,793 19,500 997,539	Dolomite. Miscellaneous stone. Building stone, borates, fuller's earth, gems, marble, pumice, tungsten concentrates.
1		5,942	98,806			17,197 tons 37,491 12,500 1,429,925	37,491 12,500 1,429,925	Dolomite. Miscellaneous stone. Alum, borates, building stone (tuff), fuller's earth, glauber salt, lime, limestone, magnesium sulphate, pumice, radio galena crystals, soda (ash and bicarbonate), tungsten concentrates.
1		5,335	89,134				1,764,891	Borates, building stone (tuff), fuller's earth, graphite, limestone, pumice, soda (ash and bicarbonate), tungsten concentrates.
234,832	\$4,364,505	140,617	\$514,075	178,400	\$219,300		\$20,409,789	

Acknowledgments.

Appreciation is here expressed for the courteous treatment and cooperation of operators and owners of properties throughout the county. Acknowledgments are especially due to Messrs. W. W. Watterson, M. Q. Watterson and Jerome Watterson, of Bishop; Paul Watterson, of Manzanar; George Lewis, of Independence; White Smith, of Bishop; Samuel Spear, of Lone Pine; Judge J. O. Ray, of Bishop; John Fox, of Trona; J. W. Banks, of Tecopa; J. R. Fairbanks, of Shoshone; L. L. Farnum, of Darwin; Walter Miller, of Keeler, and Theo. Peterson, of Darwin, for their cooperation and for the valuable information which they furnished.

The last complete survey of the mineral resources of Inyo County was published in Report XV of the State Mineralogist, pp. 29-133, and since that date there has been a considerable revival of the mining and development of both metal and non-metallic minerals. In the metal industry there has been increased activity during the years of 1925 and 1926, this being especially true in the lead-silver districts of the county where the increase in the price of lead has caused a large number of mines to be reopened.

A number of important discoveries of high-grade ore in the Cerro Gordo, Darwin, Saline Valley, Panamint, Slate Range and Tecopa districts has increased activity in mining and prospecting throughout the county. The industry never was in a more prosperous condition than at present.

METALS.

ANTIMONY.

Wildrose Mine. This property is located in Wildrose District, on the western flank of the Panamint Mountains, south of Wildrose Cañon, and 45 miles by road north of Trona. Elevation 5000 feet. Holdings comprise four patented claims and a number of claims held by location. Owner, Western Metals Company, Great Republic Life Building, Los Angeles. M. Elsasser, president.

Irregular veins of stibnite, varying in width from a few inches to over a foot, are deposited in schist. The general trend of the stringers is east and west, and their outcrops can be traced for several thousand feet along the ridge. Development consists of open cuts and tunnels.

Ore shipped from the property during 1915 to 1919 is reported to have averaged 35% in antimony.

The mine has been idle since 1919.

Bibl: State Mineralogist's Report XII, p. 21; XV, p. 60.

Williams and Johnson Mine. It is located on the eastern slope of the Argus Mountains, between Revenue and Shepherd canyons, 14 miles by road, north of Trona.

The deposits of stibnite are said to outcrop at intervals over a distance of 1500 feet. It is reported that samples taken from the cropings averaged 35% antimony. Owners, Ralph Williams and George Johnson, of Bishop, California.

The occurrence of antimony is reported on the east flank of the Panamint Mountains, near the summit of the ridge. As these deposits are very inaccessible they have never been worked and little is known as to their extent.

Bibl: State Mineralogist's Report XV, p. 62.

COPPER.

There are deposits of copper in many localities in Inyo County, but at present writing there is practically no activity in the development of these deposits. The greatest production of copper has come from its association with gold, silver and lead ores containing small percentages of copper.

Copper ores occur in the Ubehebe, Darwin and Greenwater districts. The ores are principally the oxides and carbonates of copper, with some chrysocolla, and occur occasionally as sulphides.

In the Ubehebe and Darwin districts, the ores are found mostly in the limestone, in contact with the granite or close to it. The veins are generally well defined and wide, the gangue rock consisting of siliceous iron, quartz and calcite.

The Greenwater District is located on the eastern slope of the Black Mountains south of Furnace Creek and 15 miles by road southwest of Death Valley Junction, a station on the Tonopah and Tidewater Railroad. In this district the ore, consisting of oxides of copper, principally malachite, chrysocolla, azurite and cuprite, occurs in dikes of siliceous iron in eruptive rocks, largely andesite and rhyolites.

Mines.

Anton and Pabst Mine. It is located in the Lee District, 16 miles east of Keeler. Idle. Owners, John C. Anton, Jr., and David Pabst, Lone Pine, California.

Bibl: Bull. 50, p. 306.

Blue Jay Mine. It is located on the east side of Saline Valley, in the Ubehebe District.

A siliceous iron outcrop 60 feet wide occurs on contact of limestone and granite and is 500 feet long. The ore is malachite and chalcocite. Development consists of tunnel 100 feet in length, winze 35 feet deep and a cross-cut 25 feet. Idle.

Bibl: Bull. 50, p. 310.

Butte Group of Mines. It comprises 6 claims, located midway between the Racetrack and Dodd's Spring, in the Ubehebe District. Owners, R. C. Spear, E. L. Spear and B. R. Hunter, of Lone Pine. There is a wagon road to the property from Bonnie Claire, Nevada, a distance of 65 miles.

In 1912, 100 tons of ore were shipped from the property, reported to average 24% copper and \$10 in gold and silver per ton.

Development consists of three tunnels on the vein, totaling 300 feet in length, the greatest vertical depth below outcrop being 150 feet. Idle.

Bibl: State Mineralogist's Report XV, p. 71.

Copper King Mine. It is located two miles south of the Racetrack, in the Ubehebe District, 60 miles by road from Bonnie Claire, Nevada. Elevation 4000 feet. Owners, R. McMahan, C. W. Bretz and G. K. Collins, Bishop, Inyo County, California.

The ore, consisting of oxides and sulphides of copper, occurs in a vein along the contact of lime and granite. The vein strikes east and dips south.

Development consists of two tunnels, each 40 feet in length, and about 50 feet of drifts. Idle.

Bibl: State Mineralogist's Report XV, p. 71.

Copper King and Star Mines. Ubehebe District. Idle.

Bibl: Bull. 50, pp. 309-310.

Coso Copper Company (Fernando Mine), The holdings of the company comprise nine patented claims, located in Sec. 24, T. 19 S., R. 40 E., in the New Coso Mining District, one mile southeast of Darwin and 25 miles by road southeast of Keeler. Elevation 4850 feet.

A fissure vein in the limestone averages four feet in width. The vein strikes N. 45° W., dips 65° SW. The vein matter, consisting of siliceous iron, quartz and calcite, is mineralized with oxides of copper and iron, carrying values in gold and silver.

Development consists of an incline shaft sunk to a depth of 175 feet on the vein, with short drifts on the 20-foot and 50-foot levels and a tunnel 100 feet driven on the vein. Fifty tons of ore were shipped from the property in 1916. Under lease to Theo Peterson, of Darwin.

Bibl: State Mineralogist's Report XV, p. 72.

Green Monster Mine. It is located seven miles east of Independence on the west flank of the Inyo Range. Owner, Martin Luther, of San Jose. Idle.

Bibl: Bull. 50, p. 306; U. S. G. S. Bull. 540, p. 72.

Greenwater Mine. It is located 15 miles southwest of Death Valley Junction, in the Greenwater District. Idle.

Bibl: State Mineralogist's Report XV, p. 73; Bull. 50, pp. 317-322.

Jumbo Mine. It is located on the west slope of Inyo Range, seven miles southeast of Keeler, in the Cerro Gordo District. Elevation 5700 feet. Idle.

Bibl: State Mineralogist's Report XV, p. 73.

Loretto Mine. It is located in the range of mountains west of Eureka Valley, 28 miles east of Big Pine. Elevation 5790 feet. Owner, Loretto Mining Company, of New York. Idle.

Bibl: State Mineralogist's Report XV, p. 73.

Navajo Chief Mine. Ubehebe District. Idle.

Bibl: Bull. 50, pp. 303-304.

Oasis Copper Mine. It is located in the Deep Springs District, 30 miles southeast of Big Pine and about two miles south of Oasis. Owner, Oasis Copper Corporation, New York. Idle.

Bibl: State Mineralogist's Report XV, pp. 73-74.

San Rafael Group of Claims. Located on the west slope of the Panamint Range, one mile north of Tuber Canyon and 40 miles by road north of Trona. Idle.

Bibl: State Mineralogist's Report XV, p. 74.

Settle Up Group of Claims. Located in the Ubehebe District, five miles north of Dodd's Spring and 60 miles by road southwest of Bonnie Claire, Nevada. Idle.

Bibl: State Mineralogist's Report XV, p. 74.

Wonder Mine. It is located one and one-half miles east of Darwin in the New Coso Mining District. Elevation 4750 feet.

The ore, consisting of oxides and occasional sulphides of copper, occurs in a vein of quartz in a metamorphosed limestone. The vein has a width of four feet, strikes N. 20° W. and dips 55° W. The outcrop can be traced on the surface for 500 feet and is four feet wide. Development consists of several tunnels driven on the vein, the longest being 100 feet. The ore mined is said to average 6% in copper, with \$2 in gold and silver. Idle. Richard Wallace, of Darwin, owner.

GOLD.

Actual gold mining in Inyo County started with the establishment of the Russ Mining District, in the Inyo Mountains east of Independence, in 1861. At about the same time the Kearsarge District was established on the eastern flank of the Sierras below Kearsarge Peak, at an altitude of 8000 to 10,000 feet.

The gold placers of Mazourka Canyon, which is located on the western slope of the Inyo Mountains, east of Independence, were worked with dry washers. These placers have been practically worked out.

The gold deposits of the Inyo and White mountains have, thus far, been the most productive, but at present writing most of the mines in this region are idle. The Beveridge District, situated along the summit of the Inyo Mountains, east of Lone Pine, was the most important producing district. There has been very little development in this district during recent years, owing to the fact that it can only be reached by trail from Lone Pine or Saline Valley.

In recent years gold mining in the county has been principally confined to the few scattered mines of the Funeral, Panamint and Argus mountains. During the year, 1926, there has been some activity in the development of gold properties in the Snow Canyon and Wildrose districts.

Big Horn Mine. It comprises five claims located in the Beveridge Mining District, 10 miles northeast of Owenyo, a station on the California and Nevada Railroad, on the east slope of the Inyo Mountains. Elevation 8000 feet. Owner, Sam Spear, of Lone Pine, California.

The vein, which occurs in the granite, has an average width of three feet. It strikes northeast and dips 40° to the northwest. The quartz carries considerable iron oxide; the sulphide ore shows some chalcopyrite and pyrite associated with iron oxide in a quartz gangue. The ore was formerly worked in arrastres in Hunter Canyon.

Development consists of an upper tunnel driven 300 feet on the vein and a tunnel driven at a lower elevation, 200 feet in length. There is also an incline shaft sunk 380 feet on the vein. Reported production is \$40,000. Idle.

Black Eagle Mine. It is situated on the west flank of the Inyo Mountains, four miles east of Kearsage Station. Elevation 8030 feet. Holdings comprise three claims known as Black Eagle, White Eagle, Bellview and Black Eagle Millsite. Owner, A. T. Smith, of Keeler, California.

There are three parallel veins on the property, only one of which has been developed. The main vein, Black Eagle, occurs on the contact of granite and limestone. The vein trends N. 70° E., and dips nearly vertical, with a slight inclination to the south. Northeast of the shaft, the vein splits, and the west branch strikes N. 50° E.

The developments consist of a shaft 310 feet deep sunk on the Black Eagle vein, with levels at 40, 100, 150, 200 and 300 feet. On the 40-foot level there is a drift northeast 175 feet; on the 100-foot level drifts 75 feet NE. and 70 feet SW. On 150-foot level drift NE. 200 feet and SW. 188 feet. On 200-foot level drifts run NE. 100 feet and SW. 325 feet. The 300-foot level is drifted SE. 150 feet. Ore stoped from the 100-foot level to surface, a distance of 140 feet in length. The vein varies in width from 18 inches to three feet. The vein material is quartzose, though carrying a little barite. Pyrite is the only sulphide noted, and its oxidation has given rise to earthy hematite, limonite, and ferruginous jasper. The ore mined from the upper levels is reported to have been high grade and was sorted up to \$100 per ton in gold. The ore treated in the mill is reported to have an average value of \$21 per ton and a recovery of \$15 per ton was made, with \$6 per ton in the tailings. There are about 800 tons of tailings stored below the mill. The mill is located at Willow Springs, 2800 feet below the mine. It consists of two 1000-pound stamps, driven by a 5-h.p. gas engine. The mine was under operation during 1916-1917. It is now under option to Paul Watterson and associates, of Lone Pine, California. Idle.

Bibl: State Mineralogist's Reports XV, p. 75; XVII, p. 279.
U. S. G. S. Bull. 540, p. 116.

Buckeye Mine (Never Rest Mines). It is situated in the Fish Springs District on the east slope of Poverty Hills, eight miles south of Big Pine. Owners, Buckeye Mining and Smelting Company, Chicago, Illinois.

The orebody occurs at contact of a lime-shale series and monzonite porphyry. The general trend of the orebody is northward, and is said to vary up to 60 feet in width.

Developments consist of 150-foot shaft and open-cuts. Due to low tenor of the ore, operations were suspended in 1919 and the mill has been dismantled.

Bibl: State Mineralogist's Report XVII, p. 279.

Cashier Mine. It is situated in the Wildrose District, 55 miles north of Trona and nine miles south of Skidoo, at the old town of Harris-

burg. Elevation 5000 feet. Owner, Cashier Mining Company, Los Angeles, California.

The orebody occurs as irregular lenses in the limestone, the width varying from six inches to 12 feet. The ore is free-milling gold quartz, carrying \$20 per ton.

Developments consist of a 400-foot incline shaft with levels at 100, 200, 300 and 400 feet. Idle.

Bibl: State Mineralogist's Report XV, p. 76.

Chloride Cliff Mine. The mine is situated 18 miles west of Rhyolite, along the summit of the Funeral Mountains. Elevation 5300 feet. Idle.

Bibl: State Mineralogist's Report XV, pp. 76-77; U. S. G. S. Bull. 285, pp. 72-73.

Cinnamon Mine. It is situated in the Beveridge Mining District, 10 miles northeast of Mount Whitney Station. Elevation 6500 feet. Owners, F. M. Hess and A. W. Hess, of Lone Pine, California. The mine is reached over a trail from Mount Whitney Station.

The orebody is a vein of quartz two feet in width that occurs in the granite. The vein trends northwest and dips 40° to the southwest.

Development consists of two tunnels driven on the vein. The upper tunnel is 150 feet in length and the lower tunnel is 350 feet in length. The ore is reported to carry \$30 per ton in gold. There is a small two-stamp mill on the property. Idle.

Bibl: State Mineralogist's Report XVII, p. 279.

Cleveland Mine. It is situated in the Fish Springs Mining District, on the east slope of low granite hills which are on the western edge of Owens Valley, and six miles south of Big Pine. Owner, Joseph Mear, of Big Pine. Under option to Gowman Mining Company, of San Luis Obispo, California. Dr. H. H. Gowman, president; Edgar Lewis, superintendent.

Holdings comprise seven claims, known as Cleveland, Cleveland Fraction, Cleveland Extension, Gold Bug, United, United No. 4 and United No. 5.

A series of parallel narrow quartz veins occur in the granite. These veins strike northeast and dip 15 to 20 degrees to the northwest. The veins vary in width from eight to 12 inches.

Developments consist of a number of tunnels driven at different elevations on the veins. At an elevation of 4800 feet, the main working tunnel has been driven west 625 feet, along a fault. At 400 feet from the portal, a cross-cut has been driven north 115 feet, cutting one of these veins.

The ore is iron-stained quartz, heavily mineralized with pyrite. A product of \$100 per ton in gold can be obtained by sorting. During 1926 a number of shipments have been made to the Selby Smelter. The company has constructed a 5-stamp mill, which is located at Birch Creek one and a half miles southeast of the mine. Equipment consists of a 7½" x 6" Chicago pneumatic compressor driven by a 20-h.p. gas engine. Four men employed.

Bibl: State Mineralogist's Report XVII, pp. 279-280.

Cometti Mines. These mines are situated six miles south of Big Pine, in the Fish Creek Mining District, on the east slope of low granite hills on the western edge of Owens Valley. Elevation 4500 feet.

Holdings consist of five claims, with 3000 feet on the lode. Owner, Cometti Mines Company. J. R. Gibson, president; Thomas Cornell, secretary, Boston, Massachusetts.

Two parallel veins of quartz occur in granite. These veins strike east and dip 80° south. The fissures are six to eight feet in width with a porphyry filling in the center, and 12 to 18 inches of quartz on both walls. The quartz is iron-stained with a small percentage of pyrite, and is said to carry \$20 per ton in gold.

Developments consist of three tunnels driven west on the south vein. Lower tunnel is 300 feet in length, with a winze 200 feet on the vein. At 100 feet below the collar of the winze, a drift has been run 385 feet west. At 200 feet a level has been driven 60 feet west. The ore developed in these workings is reported to carry \$30 per ton in gold.

About 100 feet in elevation above this tunnel is an intermediate tunnel driven west 800 feet. Three shoots of ore were developed on this level about 75 feet in length and 150 feet apart. The first shoot was intersected 100 feet from the portal. These shoots of ore were stoped to the surface and about 60 feet below the level. It is reported that the production was over \$100,000. About 500 feet north of the main vein, a cross-cut tunnel has been driven north 100 feet, cutting a parallel vein, with a drift west on the vein 200 feet. On Birch Creek, one mile southeast of the mine, there is a 3-stamp mill. The equipment consists of a 10" x 12" Fairbanks Morse compressor driven by a 30-h.p. Western gas engine, 15-h.p. hoist, air drills, mine cars and blacksmith shop. The property was purchased by the company in September, 1923, and operated until May 15, 1925, when operations were suspended. Idle.

Bibl: State Mineralogist's Report XVII, p. 280.

Champion Group of Mines. It comprises nine claims situated 16 miles west of Shoshone and six miles east of the Confidence Mill, on the western slope of the Black Mountains. Elevation 1500 feet. Owners, S. M. Barber and F. M. O'Conner, of Los Angeles.

The orebodies are in quartzose schist or gneiss and the mineralization parallels the stratification in certain layers of the schist. The silicified hornblende schist carrying values in gold dips 40° to 45° east, with a strike of N. 30° W. The veins vary from two to 20 feet in width.

Developments consist of a number of open-cuts and short tunnels. At present they are sinking a vertical shaft on vein exposed by an open-cut in a small gulch south of Confidence Wash.

Confidence Mine. It comprises several patented claims, situated 14 miles west of Shoshone and eight miles east of the Confidence Mill, on the western slope of the Black Mountains. Elevation 2500 feet.

A series of parallel quartz veins occur in a silicified hornblende schist. The veins trend N. 30° W. and dip 40° east. Widths vary from two to six feet.

Developments consist of a number of tunnels and open-cuts. The ore from this property was milled in the Confidence Mill in Death Valley. The mill has been dismantled and the property has been idle for years.

Eureka Mine. It is situated on the east side of Owens Valley at the foot of the Inyo Mountains, nine miles northeast of Independence. Elevation 4000 feet. Idle.

Bibl: U. S. G. S. Bulletin 540, pp. 115, 116.

Gold Spur Mine. It is situated in the South Park Mining District, 15 miles south of Ballarat. Idle.

Bibl: State Mineralogist's Report XV, pp. 77, 78.

Golden Eagle Mine. It is situated in the Beveridge District, 10 miles northeast of Owenyo, a station on the California and Nevada Railroad. Owner, John C. Anton, of Lone Pine, California.

Bibl: State Mineralogist's Report XV, p. 78.

Golden Treasure Mine (Ashford). It is situated on the western slope of the Funeral Mountains, 30 miles by road due west of Shoshone. Elevation 2000 feet. Owners, Henry J., Lewis R. and Harold Ashford, of Shoshone.

There are four veins that occur in gneiss. These veins vary in width from two to four feet. The vein quartz shows free gold, associated with some chalcopyrite. The principal development work has been on the Golden Treasure vein. A tunnel has been driven on this vein about 200 feet and a winze sunk from this tunnel to a depth of 60 feet. Over 2000 feet of tunnels and drifts have been driven on the four veins.

The ore from the mine is treated in a mill located five miles southwest of the mine in Death Valley. The ore milled is said to average \$40 per ton in gold. Four men are employed.

Bibl: State Mineralogist's Report XV, pp. 78, 79.

Harrisburg Mine. It is situated in the Wildrose District, 55 miles north of Trona, and adjoins the Cashier Mine. Elevation 5000 feet. Owner, J. P. Augerebery, Harrisburg, California. Idle.

Bibl: State Mineralogist's Report XV, p. 79.

Iron Sides Mine. It is situated in the Beveridge District, 10 miles northeast of Mount Whitney, a station on the California and Nevada Railroad. Elevation 8000 feet. Owner, Mrs. Kate Wells, of Big Pine.

The vein follows a limestone porphyry contact and has an average width of 18 inches.

Development consists of a shaft 156 feet deep and a tunnel 700 feet in length, with about 2000 feet of drifts.

Ore milled is reported to carry from \$20 to \$40 per ton in gold. Equipment consists of a gasoline hoist and compressor. Idle.

Bibl: State Mineralogist's Report XVII, p. 280.

Jumbo Mine. It is located southwest of the Black Eagle Mine, on the west flank of the Inyo Mountains, four miles east of Kearsarge.

Elevation 8000 feet. Owner, Clarence Johnson, Independence, California.

Holdings comprise six claims. The vein trends N. 70° E. and dips nearly vertical. Developments consist of several tunnels and shafts. Idle.

Keane Wonder Mine. This mine is located in Sec. 6, T. 29 N., R. 1 E., 22 miles by road west of Rhyolite, on the west slope of the Funeral Mountains, at an elevation of 3400 feet. Owned by B. H. Tatum Estate and State Bank and Trust Co., of Carson, Nevada.

Reported production of the property is \$1,100,000. Idle.

Bibl: State Mineralogist's Report XV, pp. 79-81.

Kearsarge (Cliff) Mine. Kearsarge District. Situated 12 miles west of Kearsarge, a station on the California and Nevada Railroad, on the east slope of the Sierras, at an elevation of 8000 feet.

Veins of quartz six inches to one foot wide in granite, carrying gold and silver values.

Developments consist of a number of shallow shafts and short tunnels. Idle.

Bibl: State Mineralogist's Report XVII, p. 280.

Keynote Mine. It is situated in the Beveridge District, 10 miles northeast of Owenyo, a station on the California and Nevada Railroad, on the west slope of the Inyo Mountains. Elevation 7500 feet. Owner, O. S. Williams, Los Angeles, California.

The vein occurs on the contact of granite and porphyry. It trends north and dips 40° west.

Development consists of seven tunnels, varying from 150 to 750 feet in length. Greatest vertical depth below outcrop is 1800 feet. The mine was operated continuously from 1878 to 1886, then at intervals until 1907. Assessment work only has been done since.

Bibl: State Mineralogist's Report XV, p. 81; Register of Mines, Inyo County, 1902; Report of the Director of the Mint upon Production of Precious Metals in U. S., 1883, p. 159; U. S. G. S. Bull. 540, p. 112.

Last Chance Group of Mines. It comprises 10 claims located on the west slope of the Black Mountains, 16 miles west of Shoshone. Elevation 1500 feet. Owners, L. V. Twining, Fred C. Coryell and S. M. Basher, of Los Angeles.

A quartz vein that trends N. 30° E., and dips 40° SE., occurs in schist. The vein has a width of 12 inches to two feet. The vein quartz carries considerable iron oxide and is stained with copper oxides. The schist, near contact of the vein, carries gold. A number of short tunnels from 20 to 41 feet in length have been driven on the vein at different elevations. Equipment consists of Cole dry concentrator driven by a 3-h.p. gas engine. Idle.

Lost Burro Mine. It is situated in the Ubehebe District, 55 miles southwest of Bonnie Claire, Nevada, in the Panamint Range. Elevation 5350 feet. Owner, Lost Burro Mining Company, Los Angeles, California. W. H. Blackmer, president.

Fissure veins in granodiorite, strike north and dip to the east. The veins vary in width from six inches to four feet. Development consists of several short tunnels driven along the vein. Idle.

Bibl: State Mineralogist's Report XV, pp. 81-82.

Lucky Bill Mine. It comprises three claims situated on the east slope of the Sierra Nevada Range, west of Pine Creek and 20 miles by road west of Bishop. Elevation 8000 feet. Owners, E. R. Elliott, George Cross and A. W. Hass, of Bishop, California.

A narrow quartz vein occurs in granite along a diorite intrusion. The vein is 12 inches to two feet wide, trends east and dips 40° south. The vein quartz is mineralized with pyrite, sphalerite, chalcopyrite and in places shows some free gold.

Developments consist of a number of short tunnels and open-cuts on the vein. A jig-back tram extends from the workings to Pine Creek. Two men are employed.

Marigold Mine. It is situated in the Coso District, seven miles south of Darwin and 30 miles southeast of Keeler, on the east slope of the Coso Mountains. Elevation 6000 feet. Owners, J. O. and L. W. Lee, of Darwin, California.

The vein is six inches to four feet wide in granite. Development consists of seven tunnels driven on the vein, totaling about 2000 feet. Idle.

Bibl: State Mineralogist's Report XV, p. 82.

Merry Christmas Mine (St. George Mine). It is situated in the Modoc District, in Snow Cañon, 12 miles east of Darwin and 28 miles north of Trona on the east slope of the Argus Range. Elevation 5000 feet. Owner, John C. Cress, of Darwin. Under option to N. N. and Gill Brown and George O'Neill, of Bakersfield.

The vein system consists of a series of parallel veins of quartz following a contact between andesite and granite with trend northwest. The main vein has a width of four feet. The ore is base, carrying about 1½% lead and some copper, with an average value of \$11 per ton in gold. A 700-foot tunnel is driven on the main vein. The operators propose to develop the several veins by a 3000-foot tunnel.

Equipment consists of compressor, drills and five 1000-pound stamps, driven by a 25-h.p. Western gas engine. Two men are employed.

Bibl: State Mineralogist's Report XV, p. 82.

Mountain View Mine. It is situated in the Beveridge District, adjoining the Keynote Mine, on the west slope of Inyo Mountains, 10 miles northeast of Owenyo, a station on the California and Nevada Railroad. Elevation 8000 feet. The orebody consists of a well-defined quartz vein three feet in width, carrying rusty gold and chalcopyrite.

Development consists of a tunnel driven 165 feet on the vein.

Bibl: State Mineralogist's Report XV, p. 82.

O. B. J. Mine. It is situated in Tuber Cañon, 15 miles north of Ballarat, in the South Park District. Elevation 4000 feet. Owners, Clair Tyler, J. P. Flint and J. C. Kennedy, Los Angeles, California.

Development consists of a tunnel driven 1000 feet on the vein. The ore is said to have an average value of \$7 per ton in gold. There is a 6-stamp mill on the property. Idle.

Bibl: State Mineralogist's Report XV, p. 82.

Orando Mine. It is situated 12 miles north of Trona, on the east slope of the Argus Range of Mountains. Elevation 3500 feet. Owner, Orando Mining Company, of Los Angeles, California.

There are three parallel veins in granite, the main vein with a width of 8 feet, the other two veins with an average width of two feet. The veins strike N. 30° W. and dip 35° SW.

Developments consist of an incline shaft 600 feet deep, sunk on the footwall of the vein, with levels driven at 100-foot intervals. At level of the collar of the shaft, there is a tunnel 250 feet in length. The ore mined is reported to carry from \$6 to \$20 per ton in gold. The ore in former years was treated in a cyanide plant having a capacity of 80 tons per 24 hours. Idle.

Pine Mount Group of Mines. The property is situated two miles north of Payson Cañon, on the toll road to Deep Springs Valley.

Holdings comprise 7 claims. Owner, Chas. W. Alvord, of Big Pine, California.

A vein of quartz four feet wide occurs in granite, said to carry \$20 in gold per ton. Idle.

Bibl: State Mineralogist's Report XVII, p. 281.

Protection Group of Mines (Burro Mine). This group of mines is situated 35 miles northeast of Trona, in Jail Canyon, at an elevation of 4000 feet. Owner, H. M. Thurman, Trona, California.

A series of parallel quartz veins in schist trend northwest. The veins vary in width from two to 10 feet.

Developments consist of a shaft 116 feet deep, tunnel 200 feet in length, also a number of short tunnels and shallow shafts on the different veins. The ore is reported to carry from \$2.50 to \$25 per ton in gold. Idle.

Bibl: State Mineralogist's Report XVII, p. 281.

Radcliff Mine. It is situated in the South Park District, five miles southeast of Ballarat. A vein of quartz in schist trends northwest and dips 60° southwest.

Development consists of an incline shaft on the vein to a depth of 500 feet. Idle.

Bibl: State Mineralogist's Report XV, p. 83.

Rainbow Mine. It is situated in the Coso Mining District at Cactus Flat, 10 miles southeast of Olancho, a station on the Southern Pacific Railroad. Elevation 5000 feet. Owners, Nance Rossiter and H. A. Curry, of Los Angeles, California.

Two parallel quartz veins occur in rhyolite porphyry. The veins vary in width from 12 inches to two feet.

Developments consist of a shaft 65 feet deep on one vein and a tunnel 300 feet in length on the other vein. The quartz shows considerable gold. The average value is said to be about \$20 per ton in gold. The

owners have recently completed a 60-ton mill which is located five miles from the mine, at the upper end of Haiwee Reservoir.

Mill: 50-ton storage bin. From the bin, material goes to a Colorado impact screen, where it is screened to $\frac{1}{4}$ " size. Oversize from screen goes to 6" x 8" rock crusher. The $\frac{1}{4}$ " material is fed by a Challenge ore-feeder to a Victor mill, where it is ground to pass 60 mesh. The pulp from the mill then goes to a Casad amalgamator and finally to a Deister table. Mill is driven by a 25-h.p. West Coast gas engine. Idle.

Reward and Brown Monster Mines. The property is located two miles east of Manzanar station on the Nevada and California Railroad. Elevation 4000 feet.

The country rock in the vicinity of the Reward Mine consists of a stratified series of limestones of Carboniferous age, but to the southwest there are Triassic rocks. The strata strike generally northwest, but as they have been intensely folded, the dips are extremely variable. The Reward vein conforms to the bedding of the inclosing rocks. The hanging wall of the vein is dark blue limestone. The vein strikes N. 40° W. and dips from 15° to 40° NE. The width of the vein varies from a few inches up to 10 feet, the average width being four feet.

The Brown Monster vein strikes northwest and dips from 25° to 50° east. The Reward vein is developed by a cross-cut tunnel 750 feet to the vein, with a drift on it of 300 feet.

Workings above this tunnel consist of six levels. The Reward workings are on the south side of Reward Gulch, while those on the Brown Monster Mine are on the north side of the gulch.

The Brown Monster vein is developed by an incline shaft sunk on the vein to a depth of 200 feet. Several short drifts have been driven north on the vein. The ore is a coarse white quartz, carrying a small percentage of sulphides, as pyrite, galena, chalcopyrite and sphalerite. The ore milled is said to have an average value of \$12 per ton in gold. Idle.

Bibl: State Mineralogist's Reports VIII, p. 263; XII, p. 136; XIII, p. 180; XV, p. 83. Reg. of Mines Inyo Co. 1902. Report of the Director of U. S. Mint, 1883, p. 160. U. S. G. S. Bull. 540, pp. 116-118. U. S. G. S., Professional Paper 110, pp. 121, 122.

Skidoo Mine. It is situated in the Wildrose District, 65 miles by auto road north of Trona. Elevation 6500 feet. Owner, Skidoo Mines Company, Skidoo, California.

It is reported that the property is being reopened. There are two systems of quartz veins that occur in a pegmatite granite. The main vein system strikes northwest and dips from 30° to 40° to the southwest. The other system trends east and dips 60° north. The veins average from 18 inches to two feet in width, with a maximum width of four feet. The ore is free milling and values average about \$15 per ton in gold. The outcrops of eight veins have been mined.

Development consists of an incline shaft 300 feet deep sunk on the east system of veins and a vertical shaft 300 feet deep on the main vein system. There is a 10-stamp mill and cyanide plant on the property. Total production to date is over \$1,500,000.

Bibl: State Mineralogist's Report XV, pp. 83-84.

Washington Mine. It is situated on the eastern slope of the Alabama Hills, about one mile west of Lone Pine. Owner, Felix P. Meyson, of Lone Pine, California.

A vein of quartz four feet wide occurs in granite. The vein strikes northwest and dips slightly to the southwest. A crosscut tunnel has been driven 700 feet to the vein, with drifts on the vein at a distance of 200 feet. Vertical depth below outcrop is 200 feet. The ore is said to average \$20 per ton in gold. Idle.

Bibl: State Mineralogist's Report XVII, p. 281.

Wilshire Bishop Creek Mine. The property is located in the Bishop Creek District, 26 miles southwest of Bishop, on the eastern slope of the Sierra Nevada Mountains, at an elevation of 8500 feet. Owner, Rocky Point Consolidated Mines Company, Gaylord Wilshire, president, Los Angeles, California.

Holdings comprise 12 patented mining claims located on the headwaters of Bishop Creek.

The orebody occurs in a quartzite dike which cuts the granite in a N. 50° W. direction and dips 60° to the south. This dike averages about 800 feet in width. The orebody in the dike has no well-defined walls, and the mineralization occurs on lines of fracturing in the quartzite, as shown by quartz stringers in the dike. The gold occurs in a very fine state in the quartzite, associated with pyrite, a small percentage of arsenical pyrite and pyrrhotite. Most of the gold is contained in the sulphides of iron. The ore-shoot developed is 100 feet in length, about 8 feet wide and said to average \$8 to \$10 per ton in gold. The mineralized zone has been developed by means of a vertical shaft 300 feet deep, with levels at 200 and 300 feet. On the 200-foot level the orebody has been developed for a distance of 315 feet. On the 300-foot level the development consists of 460 feet. There is a flotation plant on the property. Electric power is furnished by the Southern Sierras Power Company. Idle.

Bibl: State Mineralogist's Reports XV, p. 85; XVII, pp. 281, 292.

Wonder Mine. It is situated in the Saratoga District, north of the Ibex Mine, 10 miles southwest of Tecopa, on the east slope of the Argus Range. Elevation 3000 feet. Idle.

Bibl: State Mineralogist's Report XV, p. 85.

Yucca Mine. It is situated in the Coso District, 8 miles by road south from Darwin. Elevation 6000 feet. Owner, L. D. Owen, of Darwin.

A series of oxidized quartz veins occur in granite, strike north and dip 30° east. Veins vary in width from several inches to two feet.

Developments consist of two incline shafts 200 feet deep, with 500 feet of drifts. Idle.

Bibl.: State Mineralogist's Report XV, p. 85.

IRON.

Deposits of iron occur in the Coso range of mountains, and the ore from these deposits was formerly used for flux at the Darwin and Keeler smelters.

Coso Iron Deposit. This deposit is located 12 miles east of Olancho, on the north slope of the Coso Mountains, in the Coso Mining District. Elevation 5650 feet.

Holdings comprise 22 claims, held by location. Owner, G. W. Dow and associates, of Lone Pine, California.

Veins of iron occur in granite, which vary from a few feet to 100 feet wide, and can be followed along their outcrops for a distance of 1000 feet. Several quarries were opened up on the croppings. The ore extracted was hauled to Darwin for use as flux in the smelters that were operated in the early sixties. It is estimated that this deposit contains 3,000,000 tons of commercial ore. The ore is predominantly hematite, but here and there consists of masses of magnetite. Much of the hematite contains disseminated magnetite, making it magnetic. A considerable amount is very pure and high-grade, containing between 60% and 64% metallic iron, and less than .06% phosphorus. Analysis: Iron, 64.25%; phosphorus, 0.057%; silica, 4.49%; sulphur, 0.22%. Idle.

Bibl: State Mineralogist's Report XV, p. 87.

LeCyr Iron Deposit. It is situated 15 miles southeast of Olancho on the north slope of the Coso range of mountains. Elevation 5600 feet. Owner, J. R. LeCyr, of Keeler, California.

Holdings comprise six claims held by location.

A series of parallel veins occur in granite. The ore is hematite and magnetite, reported to carry 56% metallic iron. Idle.

Roper Iron Deposit. This deposit is located seven miles east of Kearsarge, a station on the California and Nevada Railroad, in the Inyo Mountains. The ore is specular hematite, said to carry values in gold.

Developments consist of a tunnel and shaft. Idle.

Bibl: State Mineralogist's Reports XV, p. 87; XVII, p. 282.

LEAD, SILVER, ZINC.

The earliest mining in Inyo County was that of the lead-silver ores in the southern part of the county, by Mormon colonists, previous to 1859. The famous Cerro Gordo District was discovered between 1862 and 1866. During those years the mines were worked by Mexicans on a small scale, the ores being smelted in 'vasos,' (a small reverberatory for reducing rich ores). The mines were taken over by Americans in 1869 and were worked from 1869 to 1877.

Zinc ores were first mined in 1907, with discovery of large bodies of smithsonite in the old lead stopes at Cerro Gordo.

Two smelters were erected at Cerro Gordo and a third one on Owens Lake in the early seventies. The mining of lead-silver ores in the Darwin District was from 1870 to 1877, during which period three smelters were erected. During 1925 and 1926 there was a notable increase in the mining of lead-silver ores, due mainly to the increase in the price of lead, with the resultant reopening of old mines and the developing of many new properties. The principal output of lead in California has been from silver-lead ores from Inyo County. The

Cerro Gordo District is said to have yielded to date over \$15,000,000 and the Darwin District approximately \$3,000,000.

Bibl: State Mineralogist's Reports X, pp. 213, 214; XV, pp. 87-88. Min. Res. West of the Rocky Mts., R. W. Raymond, 1870, pp. 17-19; 1873, pp. 18-22; 1876, pp. 30-32. Report of Director of Mint upon the Production of Precious Metals for Year 1883, pp. 161-163; 1884, pp. 102, 103; U. S. G. S. Bull. 540, Adolph Knopf, pp. 95-110. U. S. G. S. Prof. Paper 110, pp. 108-116. U. S. G. S. Bull. 580, Adolph Knopf, pp. 1-18.

MINES.

American Mine (Copper-gold-silver). It is 12 miles southwest of Shoshone, a station on the Tonopah and Tidewater Railroad, on the eastern slope of the Black Mountains and four miles south of Sheeps-



View of Argus-Sterling Mine, Darwin District, Inyo County.

head Springs. Owners, Frank Mellow, J. Stocker and officials of the Pacific Coast Borax Co.

The ore occurs in a vein of barytes in a laminated schist along the contact of monzonite and granite. The vein is 18 inches to two feet wide, carrying galena, sulphides of copper with gold and silver values.

Development consists of a 50-foot incline shaft on the vein, 175-foot tunnel and several hundred feet of drifts. During 1926 shipment of ore was made carrying high values in silver. Two men are employed.

Bibl: State Mineralogist's Report XV, p. 71.

Argus-Sterling Mine (Lead-silver). It is situated in the Darwin District, on the west slope of the Argus range of mountains, 11 miles south of Darwin. Elevation 5850 feet. Owner, A. C. Taylor Estate, Gardena, California. Under lease and bond to the Silas Frank Mining Company, 1105 Story Building, Los Angeles, California. Silas Frank, president. Theo Peterson, superintendent. Holdings comprise six claims.

The country rock in the vicinity of the mine consists of blue limestone and granite, the contact of which lies south of the workings. The ore occurs in irregular masses along a fissure in the limestone which trends northwest and dips 45° northeast, but at 50 feet below the tunnel assumes a vertical dip. The footwall of the vein is blue limestone, with white lime-silicate rock as hanging wall. There has been considerable faulting of the vein. These faults strike northeast and dip 45° southeast. The fissure has an average width of three feet. The ore consists of galena, lead carbonate and zinc carbonate, carrying $\frac{1}{2}$ oz. silver to each per cent of lead. The ore shipped carries 30% lead and 15 oz. silver.

Development consists of a crosscut tunnel driven northeast 450 feet. At 150 feet from the portal it intersected the main fissure. Also a vertical shaft 155 feet deep and crosscut east on the 150-foot level to the vein, with a drift southeast on the vein 150 feet and drift northwest 200 feet. At 150 feet the vein is cut off by a fault which strikes northeast and dips 45° southeast. The orebody between shaft and fault has been stoped to the surface. Several cars of ore were shipped from the property during 1926. Idle at the time the mine was visited but expected to resume operations at an early date.

Bibl: State Mineralogist's Report XVII, p. 283.

Baxter Mine (Lead-silver). It is situated in Resting Springs District four miles east of Evelyn, a station on the Tonopah and Tidewater Railroad, on the slope of Resting Springs Mountain. Elevation 4000 feet. Owner, J. P. Madison, Shoshone, California. Idle.

Bibl: State Mineralogist's Reports XV, p. 88; XVII, p. 283.

Belmont Mine (Lead-silver). It is situated in the Cerro Gordo District, 11 miles northeast of Keeler and three miles by trail southeast of Cerro Gordo Mine. Elevation 8000 feet. Owner, W. L. Hunter Estate, Keeler, California.

Argentiferous quartz veins occur traversing a crystalline rock of granitoid texture. The ore is chiefly silver with a small percentage of lead. The silver minerals contained are tetrahedrite, argentite and stephanite. The veins vary from eight inches to six feet in width. Strike is N. 75° W. and dip 60° to 70° SW.

Developments consist of a tunnel 400 feet long and a shaft 150 feet deep. There are about 3600 feet of tunnels and drifts on the property. Past production is said to be about \$500,000. Idle.

Bibl: State Mineralogist's Report XVII, p. 283.

Big Silver Mine (Essex). It is situated on the eastern slope of the Inyo Range of Mountains, in the Ubehebe Mining District, one mile south of Hunter Creek, on the western edge of Saline Valley. The property is 50 miles by road north of Keeler, a station on the California and Nevada Railroad. Elevation ranges from 1600 to 3000 feet.

Holdings comprise two groups of claims known as Essex and Hudson, there being five claims in each group, totaling 200 acres, located in T. 13 S., R. 38 E., M. D. B. and M. Owners, Big Silver Mining Company. Paul E. Watterson, president; W. W. Watterson, vice president; J. S. Henderson, secretary. Offices, Terminal Subway Building, Los Angeles.

The formation in the vicinity of the mine is made up of Silurian and Ordovician metamorphic limestone and quartzite. The beds of limestone are cut by numerous intrusions of a fine-grained, dark-green hornblende diorite. The main area of fissuring on the property seems to be centered on the Essex group of claims and deposition of silver-bearing ore is exposed along the bedding planes of the limestone as well as in cross fractures and fissures cutting the limestone and diorite at an angle. The most intensive enrichment of the vein system occurs close to the contacts with the diorite. On the Essex group of claims the vein system is in the form of a stockwork, there being two systems of veins, one that trends east and the other trending north, forming numerous intersections. The width of the individual veins ranges from one to ten feet, carrying values distributed into the wall-rock and in some instances, at junctural points of the crossing of veins, at and along joint planes. Commercial values across much greater widths are in evidence. The dip of the easterly and westerly veins is at an angle of 70° south and in those having a strike in the opposite direction, the dip is nearly vertical. The vein matter consists of quartz mixed with a small portion of crystalline calcite. The silver occurs largely in the form of argentite with occasional sprinklings of native silver. Much of the vein matter contains bromide and chloride stains, and also carries some galena. Values of assays taken from the different veins on these claims range from 8 to 200 oz. per ton in silver. It is said the ore will average around 30 ounces of silver per ton, with from 2% to 9% lead.

Developments consist of a number of tunnels driven on the different veins at various elevations. At an elevation of 2150 feet on Essex No. 2 Claim, a tunnel has been driven S. 45° W., on a vein 250 feet. Width of this vein averages about four feet. At an elevation of 2100 feet, a jig-back tunnel has been driven 136 feet west on an east and west vein. The vein developed is from four to six feet wide and dips 70° south. Ore mined from this vein consists of 500 sacks, which by sorting is said to average 200 ounces in silver per ton. A jig-back tram from this tunnel to the plain below is 1500 feet in length. At an elevation of 2800 feet, a crosscut tunnel has been driven S. 20° E., then west on a vein a distance of 30 feet. This vein varies in width from three to six feet. The ore mined is reported to carry 30 ounces in silver per ton, and was sorted up to 200 ounces in silver per ton. There are a number of short tunnels driven on the different veins ranging in length from 20 to 50 feet. An aerial tramway, $13\frac{1}{2}$ miles in length, passes the property within a quarter of a mile. The tram-line was formerly operated by the Saline Valley Salt Company in transporting salt from the Saline Lake to a point on the western side of Inyo Range, on the California and Nevada Railroad. The power line of the Los Angeles municipal system parallels this tramway. Water is secured from Hunter Canyon. The company plans to start development work on the property on an extensive scale, during the spring of 1927. Six men are employed.

Black Rock Group of Mines (Lead-silver). This group of mines comprises six claims located north of the Gunsite Mine on the western slope of the Nopah range of mountains, seven miles east of Tecopa.

Elevation 2500 feet. Owners, William Adams and Associates, of Tecopa, California.

The orebodies occur as irregular lenses along a fissure in the dolomite. Strike of fissure is N. 45° W., dip 35° to 50° east. The ore is principally carbonate of lead, with some galena.

Development consists of a tunnel driven north 900 feet, following a fault that strikes north. There is another tunnel several hundred feet vertically above the lower tunnel that has been driven north 200 feet. A raise is being run from the lower tunnel to cut an ore-shoot worked in the upper tunnel. Equipment consists of 7" x 6" Ingersoll-Rand compressor driven by a 15-h.p. Fairbanks-Morse gas engine. Four men are employed.

Blue Dick Mine (Lead-silver-zinc). It is located in the Kingston Mountains, near the San Bernardino County line, southeast of Tecopa. Owner, Henry Lang, Tecopa, California.

Lenticular masses of lead-carbonate ore occur along a fissure in limestone.

Development consists of 500 feet of tunnels and drifts on the property. Idle.

Bibl: State Mineralogist's Reports XV, p. 89; XVII, p. 283.

Bunker Hill Mine. It is situated 35 miles northeast of Big Pine, on the eastern flank of the Inyo Mountains, between Willow Creek and Keynote Canyon. Elevation 5500 feet. Owner, Inyo Bunker Hill Mines Company; Howard R. Link, president, Earl C. Peck, secretary; 707 Maltman Avenue, Los Angeles.

The orebodies consist of irregular lenses of galena and lead carbonate ore which occur in the limestone or on the contact of limestone and porphyry. A shipment of ore made from the property in 1923 carried 70% lead, 33 ounces of silver and \$4.50 in gold per ton.

Development consists of a shaft 600 feet deep and a tunnel 400 feet in length. Idle.

Bibl: State Mineralogist's Report XVII, p. 283.

California Queen Mine No. 4 (Lead-silver). It comprises a group of claims located 10 miles northeast of Trona, on the west slope of the Slate Range. Owner, California Queen Mining Company, C. S. McCarthy, of Trona, California. Idle.

Campbird Group of Mines. (Silver). This group comprises 10 claims in the Panamint Mining District, on the west slope of the Panamint Mountains, and north of Surprise Canyon, 11 miles northeast of Ballarat. Elevation 7300 feet. Owner, L. V. Lehigh, 420 Homer Laughlin Building, Los Angeles. Chris Wicht, of Ballarat, superintendent.

Two quartz veins with widths varying from 10 to 15 feet occur in the limestone. One vein strikes east and dips 80° north, and the other vein, which is evidently a continuation of the Stuart Wonder vein, trends northwest and dips 25° northeast. These two veins form an intersection near the Jacob Wonder workings.

Development consists of a crosscut tunnel driven north 25 feet and drift east and west on the vein a total distance of 400 feet. From this tunnel level a winze has been sunk to a depth of 150 feet on the vein.

The silver mineral contained in the quartz is freibergite, a sulphanti-monite of silver. The ore mined is said to have an average value of \$10 to \$15 per ton in silver. Two men employed on development.

Carbonate Mine (Queen of Sheba). It is now known as the Queen of Sheba Group of Mines which consists of nine claims located on the eastern slope of the Panamint range of mountains, about 40 miles northeast of Zabriskie, a station on the Tonopah and Tidewater Railroad. Elevation 1200 feet. Owners, New Sutherland Divide Mining Company, of San Francisco, California. Under lease to the Victor Divide Mining Company, Reno, Nevada. A. I. D'Arcy, president.

The country rock is limestone which has been greatly faulted. The limestone is cut by intrusions of diorite. The ore occurs as replacement orebodies in limestone, being principally carbonate of lead, with some galena, and is deposited in irregular lenticular masses along a fault plane. The width of the orebodies varies from three to 15 feet. Trend N. 30° E. The ore is said to average 15% lead and 8 ounces silver per ton. The ore shipped from the property averaged 35% lead, and 15 to 20 ounces in silver per ton. The property has been worked periodically since 1914.

Development work consists of three tunnels driven on the orebody. The present company is driving a tunnel at a lower elevation to intersect orebodies worked in the upper tunnels. Six men are employed on development work.

Bibl: State Mineralogist's Report XV, pp. 89, 90.

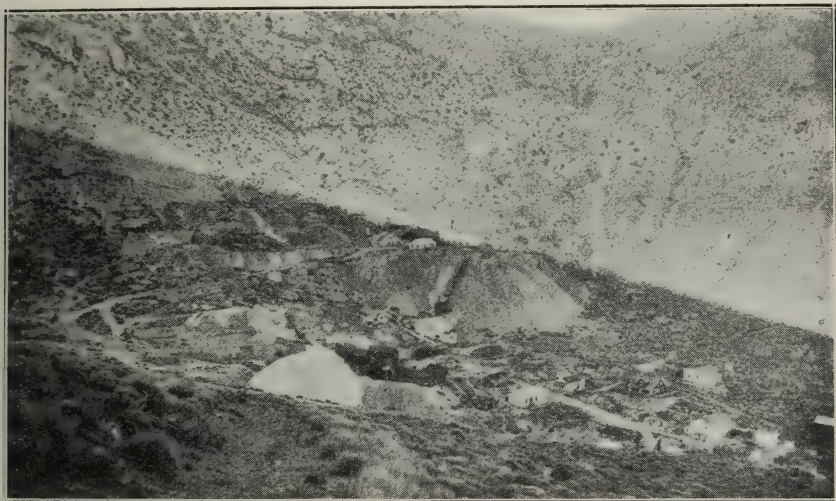
Cerro Gordo Mine (Lead-silver-zinc). It is situated in the Inyo range of mountains near the summit of Cerro Gordo Peak, eight miles by road east of Keeler. Elevation 8500 feet. Owner, Cerro Gordo Mines Company. F. J. Hambly, president; C. A. Stockton, secretary. Offices, 222 Bank of San Jose Building, San Jose, California. In February, 1923, the mine was taken over under lease to purchase by the Natural Soda Products Company, Keeler, California, W. W. Watter-son, president, J. S. Henderson, secretary, and has been under steady operation to date.

The Cerro Gordo Mine has been the most productive lead-silver-zinc mine in Inyo County. The mine was discovered in 1866 and worked continuously from 1869 to 1876 and periodically up to the present time. The zinc orebodies were worked from 1911 until September 18, 1915, resulting in a large production of zinc ore.

Development: The present company's development work is confined to the lead orebodies on the 700-, 900- and 1000-foot levels.

The lead orebodies of Cerro Gordo consist of lenticular masses distributed through a zone 2000 feet long and several hundred feet wide. The predominant rock of the ore-bearing zone is white marble. Slate and igneous rock, with dikes of diorite and porphyry, occur also within the ore-bearing zone but the orebodies that have been worked are inclosed principally in the marble. The rocks of the ore-bearing zone strike in a north to northwesterly direction and dip on the average

70° SW., the orebodies conforming to the trend of the inclosing rocks. The lead orebodies formerly worked were from three to 20 feet wide and from 30 to 70 feet in length. The ore consists largely of galena, cerussite, anglesite, also some sphalerite, tetrahedrite and pyrite. The San Felipe vein cuts diagonally across the silver-lead ore-bearing zone, trending N 35° W., dipping 70° to 80° SW. It traverses both marble and porphyry and is about 12 inches to two feet in thickness. The main ore mineral noted is tetrahedrite, with its oxidation products, azurite and malachite, inclosed in a gangue of quartz and barite. The ore now mined is through the Belshaw shaft, 900 feet deep with levels at 200', 400', 500', 700' and 900'. A winze has been sunk from the 900-foot level, 160 feet north of the Belshaw shaft. At a depth of 100 feet (1000-foot level), a crosscut is driven west 30 feet, cutting a vein of quartz two to six feet wide, which strikes N. 35° W., and dips 70° SW. The quartz is mineralized with tetrahedrite, galena, azurite and



View of Cerro Gordo Mine, Cerro Gordo District, Inyo County.

malachite. The present development is confined to the 900- and 1000-foot levels. The lead ore mined is shipped to the United States Smelting, Refining and Mining Company's plant at Midvale, Utah. The company is again mining limestone for use at the plant of the Natural Soda Products Company, located on Owens Lake. Due to scarcity of water only one shift is employed on development work at the present time. Exploration is under way to find the extension of orebodies in the southwestern area of the property on the 900-foot level, also developing on 1000- and 1100-foot levels by crosscuts to the southwest.

Equipment: Single drum hoist driven by 100-h.p. motor; one Ingersoll-Rand compressor (16" x 12") (9" x 12") driven by a 75-h.p. motor; one Ingersoll-Rand compressor (21" x 16") (12" x 16") driven by a 100-h.p. motor. A Leschen aerial tramway 29,560 feet long carries limestone to bunkers on the railroad at Keeler. Capacity of tramway is 16 tons per hour. Electric power is furnished by the Southern Sierras Power Company.

Mill equipment: 9" x 15" Blake crusher, with Dorr duplex classifier, elevators, one Colorado impact screen, one Borchart concentrator and three Wilfley concentrators. Mill is driven by a 50-h.p. motor. Twenty men are employed.

Bibl: State Mineralogist's Reports XV, pp. 90-92; XX, 185-187. U. S. Geol. Survey Bull. No. 540, pp. 97-109; Professional Paper 110, pp. 106-116.

Chalmers Mine (Lead-silver). It is situated in the Deep Springs District, 16 miles northeast of Big Pine, in the Inyo range of mountains, near Antelope Springs. Owner, Paul Bradshaw, Kane and Associates, of Hollywood, California.

The ore is galena and lead carbonate that occurs on a contact between limestone and quartz diorite. The orebody is from two to six feet wide, strikes northwest and dips 45° southwest.

Development consists of tunnels and opencuts on the vein. Four men are employed on the property, also building a road through Lyman Canyon to the mine.

Bibl: State Mineralogist's Report XVII, p. 284.

Chesamac Mine (Lead-silver) It comprises six claims located in the Wildrose District, on the east slope of the Panamint Mountains, 18 miles northeast of Ballarat.

A series of narrow, parallel veins in limestone occur, reported to carry high values in silver.

Development consists of shallow tunnels and opencuts along the outcrops. Owners, Donald MacDonald and associates, of Los Angeles. Two men are employed.

Christmas Gift Mine (Lead-silver). It is situated in the Darwin District, two miles north of Darwin. Elevation 5300 feet.

Holdings consist of five claims. Owners, William Skinner and Mrs. L. D. Skinner, of Lone Pine, California. Idle.

Bibl: State Mineralogist's Reports VIII, p. 226; X, p. 211; XVII, pp. 284-285. U. S. G. S. Bull. 580-A, pp. 10-12.

Cliff Mine (Silver). It is situated five miles south of Oasis, Mono County, but in the White Mountains of Inyo County, in the Deep Springs Mining District. Idle.

Bibl: State Mineralogist's Report XV, p. 93.

Columbia Mine (Lead-silver). It is situated in the Darwin District. Idle. Owner, Wagner Estate Corp., Chicago, Illinois. Under lease and bond to American Metals, Inc.; C. H. Lord, president.

Bibl: U. S. G. S. Bull. 580, pp. 17, 18.

Custer Mine (Lead-silver-copper-gold). It is situated in the Darwin District one mile east of Darwin. Owners, Frank Long and Chas. Grimes, of Pasadena, California.

The ore, principally lead carbonate and galena, is found in bunches in a large irregular body of coarsely crystalline calcite.

Development consists of a shaft 400 feet deep. The mine is supposed to have produced over \$250,000 to a depth of 400 feet. Idle.

Bibl: State Mineralogist's Reports XV, p. 94; XVII, p. 285.
U. S. G. S. Bull. 580, pp. 15-16.

Daisy Mine (Lead-silver). It is situated 26 miles southeast of Big Pine in the Waucoba District, on the east flank of the Inyo Mountains. Elevation 7550 feet. Owners, Hercules Mining Company, Wallace, Idaho.

Bibl: State Mineralogist's Report XVII, p. 285.

Defiance Mine (Lead-silver). It is situated in Darwin District, on the east slope of the Argus Range of Mountains, one mile north of Darwin. Elevation 5100 feet. Owner, Wagner Estate Corp., Chicago, Illinois. Under lease and bond to American Metals, Inc. C. H. Lord, president. H. E. Olund, general manager. Offices, Darwin, California. This operating company controls the following group of mines located in the Darwin District: Columbia, Defiance, Independence, Thompson, Lane and Lucky Jim, comprising about 700 acres.

The orebodies occur as irregular lenses of galena and lead carbonate, on the contact of diorite and lime-silicate rock. On the hanging wall, the ore occurs as galena in massive calcite, while on the footwall the ore is principally lead carbonate with some galena. The ore mined is said to have averaged 12% lead and carried from 8 to 10 ounces in silver per ton.

Development consists of an incline shaft 500 feet deep sunk on an angle of 35° in a monzonite footwall. The orebody was worked 500 feet in length and developed to a vertical depth of 250 feet below the outcrop. Levels are driven at intervals of 100 feet along the orebody for a lateral distance of 500 feet. At the shaft level, a tunnel has been driven 200 feet on the orebody. Equipment consists of electric driven hoist, blacksmith shop, ore bins and aerial tramway, one mile in length to the mill, located at Lane Mine. The mine is not being worked at present as development work is confined to the Independence and Thompson group of mines.

Bibl: State Mineralogist's Reports VIII, p. 226; X, p. 211; XII, p. 24; XVII, p. 285. Report of the Director of the Mint, Precious Metals in U. S. 1883-1884. U. S. G. S. Bull. 580, pp. 13-14.

Ella Group of Mines (Lead-silver). It comprises 14 claims located in the Cerro Gordo District, one mile north of Cerro Gordo and seven miles east of Keeler. Elevation 7000 feet. Owner, Lake View Mining Company, Keeler, California.

The ore occurs as irregular lenses of galena and lead carbonate along two well-defined fissures which trend northwest. Width of ore mined varies from two to six feet.

Developments comprise two tunnels with a total of 2500 feet of drifts. No. 1 tunnel is 300 feet below the outcrop of the veins and No. 2 tunnel is 300 feet in elevation below No. 1 tunnel. Idle.

Estelle Group of Mines (Lead-silver). This group of mines is located in the Cerro Gordo District five miles east of Keeler, on the western

slope of Inyo Mountains. The holdings comprise 29 claims located south and southwest of Cerro Gordo Mine. Elevation 6100 feet to 8000 feet. Owner, Estelle Mining Company; Adolph Ramish, president; Roy C. Troeger, secretary; Thomas L. Chapman, general manager. Offices, Keeler, California.

The company's operations at the time the property was visited were confined to the Dellaphene tunnel, which has been driven N. 60° E., 9000 feet, intersecting the vein on the Morning Star claim at a depth of 1700 feet, and also said to have cut the San Felipe vein developed in the Cerro Gordo Mine at a depth of 2400 feet below the Cerro Gordo Mine. The tunnel intersects Carboniferous rocks consisting mainly of limestone. At 5929 feet from the portal, a drift has been driven southeast 900 feet along a fault fracture, which is evidently a post-mineral fault as no ore was developed. Near the face of this drift, a crosscut was driven southwest to the Morning Star vein. At 6772 feet from the portal, a drift has been driven southeast 800 feet on a fault fissure; small lenses of lead carbonate and galena ore were mined from this fissure. The average width of ore mined was 18 inches. At 7676 feet from the portal the San Felipe vein was intersected. Drifts have been driven on this vein 300 feet northwest and 300 feet to the southeast. The vein strikes N. 35° W. and dips 70° to 80° SW. It traverses the limestone and ranges from 18 inches to four feet wide. The gangue is quartz mineralized with galena and pyrite, occasionally with tetraedrite. In a drift to the north from the main crosscut tunnel which is located west of the San Felipe vein, a three-compartment raise has been put up in the limestone, a distance of 800 feet. Three levels have been driven from this raise, at 140, 340 and 600 feet above the main tunnel level. Several small orebodies have been developed in the raise and on the different levels. Similar small orebodies have been developed on the main tunnel level, east and west of the San Felipe vein. These orebodies consist of lenticular masses of lead carbonate and galena, the ore being inclosed in marbleized limestone. The ore is principally reddish-yellow lead carbonate and galena, said to carry 30% lead and 30 ounces in silver per ton.

Equipment: The main tunnel is equipped with a 670-cu. ft. Ingersoll-Rand compressor driven by a 100-h.p. motor. A blower driven by a 15-h.p. motor supplies ventilation through 12" galvanized iron pipe. The tunnel is 7' x 7' in cross-section for 7300 feet and 5' x 7' for the remaining length. The ore is transported in 25-cu. ft. cars, hauled by a three-ton storage battery locomotive. The water supply is from Keeler through 1½" pipe line, 25,000 feet long, and against a head of 2500 feet. A small triplex pump driven by a 7½-h.p. motor lifts the water to the mine. The rate of flow is five gallons per minute. Storage at the mine is 15,000 gallons. Electric power is supplied by the Southern Sierras Power Company. Twenty men are employed.

Bibl: State Mineralogist's Reports XV, pp. 108-109; XVII, p. 286;

XX, pp. 187-189. U. S. Geol. Survey Bull. No. 540, p. 110.

U. S. G. S. Professional Paper 110, pp. 116, 117.

Fernando Group of Mines (Lead-silver). This group of mines is located in the Darwin District, in Sec. 24, T. 19 S., R. 40, E., M. D. M., one mile east of Darwin, adjoining the Custer and Jackass mines on the

east. Elevation 4850 feet. Owner, Coso Copper Company; F. H. Long, president, Pasadena, California. Under lease to Theo. Peterson, of Darwin.

The orebody occurs as irregular lenses of lead carbonate and galena on contact of diorite and lime-silicate rock. The vein trends east and dips 40° north. The width of the vein is from three to four feet.

Development consists of a tunnel driven 100 feet east and incline shaft 175 feet deep. Ore shipped from the property is reported to carry 30% lead and 30 ounces in silver per ton. Two men are employed.

Gibraltar Mine (Lead-silver). It is situated in South Park District, seven miles southeast of Ballarat. Elevation 7000 feet. Under lease and bond to John Thorndike, of Ballarat.

The ore occurs as irregular lenses of lead carbonate and galena in limestone. The ore shipped from the property is said to carry 30% lead and 20 ounces in silver per ton. Several men are employed on development.

Gunsite Mine (Lead-silver-zinc). It is situated in the Resting Springs District, seven miles east of Tecopa. Elevation 2350 feet. Owner, Tecopa Consolidated Mining Company; Dr. L. D. Godschall, vice president and general manager, Tecopa, California. There is a railroad from this property and the Noonday Mine to Tecopa, a station on the Tonopah and Tidewater Railroad.

The country rock is dolomite, overlaying quartzite. The ore occurs as irregular lenses of lead carbonate and galena along a fissure in the dolomite. There has been considerable faulting along this fissure which strikes N. 45° W. and dips 35° to 50° E., there being a series of parallel faults that trend north, displacing the orebodies from several feet to approximately 30 feet. The width of the orebodies worked varies from a few feet to 30 feet.

Developments consist of an incline shaft sunk to a depth of 1000 feet; crosscut tunnel 800 feet to the vein, with a drift south on the vein 900 feet. A winze has been sunk from the tunnel level (known as seventh level) to 1000-foot level. The ore mined averaged 15% to 20% lead and 6 ounces to 10 ounces in silver per ton.

The Gunsite Mine is located one mile northwest of the Noonday, and is on the same fissure. The mine was not operated by the company during 1926 and the principal production came from the Noonday and War Eagle mines. Martin Pico, of Tecopa, has a lease from the company on the old stopes and ships an occasional carload of ore from the mine. Two men are employed.

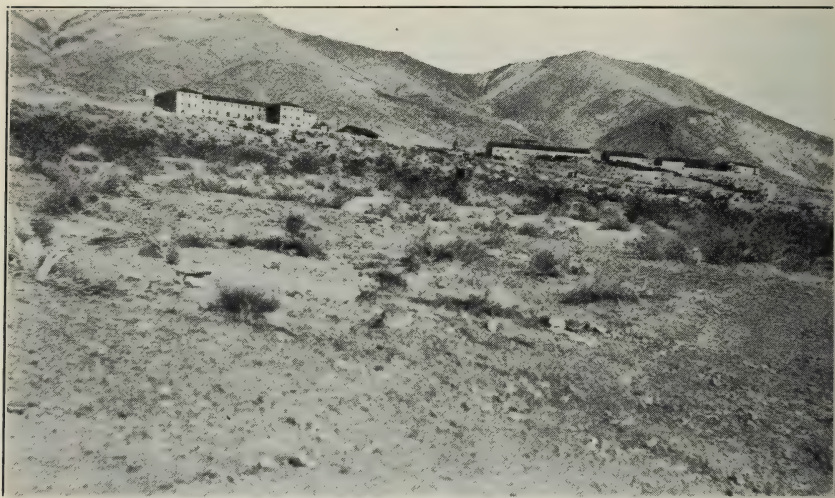
Bibl: State Mineralogist's Reports XV, pp. 95-96; XVII, pp. 286-287. Report of the Director of the Mint, Precious Metals in U. S. 1883, p. 166.

Ignacio Mine (Lead-silver). It is situated in the Cerro Gordo District, six miles east of Keeler. Elevation 7800 feet. Idle. Owner, Ignacio Mining Company. P. M. Price, president, San Diego, California.

Bibl: State Mineralogist's Reports XV, pp. 97-98; XVII, p. 287. R. W. Raymond, Mineral Resources West of the Rocky Mountains, 1870, p. 17.

Independence and Thompson Mines (Lead-silver). These two mines are located two miles north of Darwin and adjoin the Defiance Mine on the north. Elevation 5150 to 5550 feet. Owner, Wagner Estate Corporation, Chicago, Illinois. Under lease to the American Metals Company; C. H. Lord, president; H. E. Olund, manager. Offices, Darwin, California.

The orebody is situated at the contact of lime-silicate rocks with quartz-diorite which is the northward extension of the belt forming the footwall of the Defiance orebody. The general trend of the Thompson and Independence orebodies is N. 45° W. and dip 25° SW. The width of the orebodies varies from six to 20 feet. During the latter part of 1926, some very high-grade ore was encountered in the Independence workings, being the most important development of ore in the Darwin District. The ore is carbonate of lead and galena, carrying 12% to 15% lead and 6 ounces to 8 ounces in silver per ton.



American Metals Company Plant at Darwin, Inyo County.

The ore sorted from this orebody carries 30% lead and 15 ounces in silver per ton.

Development: On the Thompson group at an elevation of 5150 feet, a tunnel has been driven N. 60° W. 300 feet; at 250 feet from the portal it cuts the contact of quartz-diorite and limestone. The orebody developed was stope to the surface. The tunnel is being driven northwest to intersect the Independence orebody at a lower elevation. A raise has been driven from the Thompson tunnel 180 feet to an old open-cut and tunnel where the surface orebody was worked. Between the Thompson and Independence workings, a sulphide orebody 15 feet wide has been developed by a shaft 50 feet deep. The ore is galena, associated with pyrite, carries 15% lead and 7 ounces in silver per ton.

On the Independence group the orebody is developed by two tunnels, the upper tunnel is 200 feet in length and the lower one is 150 feet long. The orebody developed in the Independence workings has been

crosscut for a distance of 160 feet and developed for a length of 250 feet along its strike. Thickness of the ore varies from six to 20 feet.

The ore from the storage bin at Independence is transported by aerial tram to main storage bins below the Defiance Mine and then to the mill. During 1925 and 1926 practically all the ore treated in the mill has been from the Independence and Defiance mines.

Since the Seventeenth Report of the State Mineralogist was published (1920), a large hotel for employees, main office, machine shops, power house, building for supplies and residence for officials of the company have been built on the west slope of the ridge north of Darwin.

Mine equipment: A 2500-cu. ft. air compressor driven by 250-h.p. motor furnishes air for hoist and drills at Independence and Thompson mines. Machine shop is completely equipped with drill presses, lathes, timber framing machines, etc. Water for mine, mill and camp is pumped from a well in the Darwin Wash, a distance of four miles through a 4" pipe line with a lift of 1800 feet to storage tanks, by a Pratt Machinery Company Triplex pump driven by a motor. The ore from Defiance and Independence mines is delivered by aerial tram to storage bins from which it goes to a 75-ton flotation plant, located on the Lane mill site. The ore treated in the mill carries 9% lead and five ounces in silver per ton. The concentrate produced carries 50% to 60% lead and 30 ounces to 35 ounces silver per ton. Tailings carry $2\frac{1}{2}\%$ lead and $1\frac{1}{2}$ ounces silver per ton, recovery being from 75% to 80%. A 150-h.p. motor drives the mill. Concentrates from the mill are returned by aerial tram to bins at Defiance from which they are hauled by truck to Keeler for shipment over the Southern Pacific Railroad. Thirty men are employed at mines and mill.

Bibl: State Mineralogist's Reports VIII, p. 226; X, p. 211; XV, p. 98; XVII, pp. 287-288. Reports of Director of Mint, Precious Metals in U. S. 1883, p. 164; 1884, p. 103; U. S. G. S. Bull. 580, pp. 14, 15.

Jackass Mine (Lead-silver). It is situated in the Darwin District, one mile northeast of Darwin, on the east flank of the Darwin Hills. Elevation 5000 feet. Owner, Black Metal Mining Company, Los Angeles. Idle.

Bibl: State Mineralogist's Report XVII, p. 288.

Kane Group of Mines (Lead-silver). This group of mines comprises 15 claims situated on the northeast slope of the Slate Range of Mountains, 12 miles north of Trona. Elevation 3900 feet. Owner, Belcher Extension Consolidated Mines Company, No. 1 Exchange Place, Jersey City, N. J. Thomas J. Lynch, president; Frank Silva, secretary; J. R. Kelley, treasurer; A. J. Kane, superintendent.

The formation is limestone trending N. 30° W. and the beds dip 30° to 40° west. The ore occurs as galena and lead carbonate along a series of parallel fissures in the limestone. Width of ore varies from 12 inches to two feet.

Development consists of a number of shallow tunnels and open-cuts along the different croppings. There are also two vertical shafts, one 50 feet deep, the other 120 feet in depth. The company proposes to sink the latter shaft to a depth of 500 feet.

Equipment consists of air compressor and hoist, which were being installed at the time the property was visited. Twenty men are employed.

Lane Mine (Lead-silver). It is situated in the Darwin District two miles northeast of Darwin, on the east flank of the Darwin Hills. Elevation 4100 feet. Owner, Wagner Estate Corporation, Chicago, Illinois. Under lease to American Metals, Inc. C. H. Lord, president. Idle.

Bibl: State Mineralogist's Reports XII, p. 24; XIII, p. 32; XV, pp. 98-99; XVII, p. 288. U. S. G. S. Bull 580.

Lee Mine (Lead-silver-zinc). It is situated in Lee District, 18 miles east of Keeler. Elevation 5000 feet. Owners, Franklin Booth and W. A. Reid, of Keeler. Under lease to B. F. Shively, A. E. Beauregard, of Laws, California. Holdings comprise six claims.

The orebodies occur as irregular lenses along a series of parallel veins in the limestone. These veins strike east and dip 70° north. The mineralized zone in which the veins lie is about 400 feet wide and about 1000 feet in length. The ore occurs as chlorides and chloro-bromides of silver, argentite and occasional bunches of galena. The mineralization of silver ores is found along seams, fractures and bedding planes of the limestone.

Development consists of a number of shafts and open-cuts, the deepest shaft being 80 feet, and an open stope to a depth of about 80 feet. The dumps from these old workings are reported to carry 22 ounces in silver per ton. The lessees are operating a Stebbins dry concentrator on ore from dumps and old fills. The concentrates are said to carry 100 ounces in silver per ton with 20% lead. Six men are employed.

Bibl: State Mineralogist's Reports XV, pp. 99-105; XVII, p. 289.

Report of the Director of Mint, Precious Metals in U. S., 1883, p. 163.

LeMoigne Mine. (Lead-silver) It is situated in the LeMoigne District, on the east slope of the Panamint range of mountains, 15 miles southwest of Stove Pipe Wells and 50 miles by road west of Beatty, Nevada. Owner, Buckhorn Humboldt Mining Company, W. R. McCrea, manager, Reno, Nevada. Elevation 4950-5700 feet. Under lease to L. P. McCrea, M. L. Miller and associates, of Beatty, Nevada.

Massive galena and lead carbonate ore occur in irregular lenses along fissures in the limestone. These fissures strike north and south and dip 65° W. In a canyon north of the main camp, a tunnel has been driven west 25 feet intersecting a lens of ore from which 150 tons was shipped that carried 50% lead and three to five ounces in silver per ton. South of these workings on a ridge above LeMoigne Canyon, a tunnel driven 165 feet developed a lens of ore from which 100 tons was shipped, said to average 50% lead with five ounces of silver per ton. The ore was hauled by truck to Beatty, Nevada, a distance of 51 miles. The cost of hauling was \$18 per ton. Two men are employed.

Lincoln Mine (Silver). It is situated in the Deep Springs District 25 miles northeast of Big Pine and about four miles northeast of Deep

Springs ranch, on Midland trail. Elevation 6200 feet. Owners, V. Richardson and associates, of Big Pine. Idle.

Bibl: State Mineralogist's Report XVII, p. 289.

Lucky Jim Mine. (Lead-silver). It is in the Darwin District two miles north of Darwin and 24 miles southeast of Keeler. Elevation 5000 feet. Owner, Wagner Estate Corporation, Chicago, Illinois. Under lease to the American Metals, Inc.; C. H. Lord, president; H. E. Olund, manager, Darwin, California.

The country rock is limestone with intrusions of monzonite. The ore occurs as irregular lenses of lead carbonate and galena along a fissure that cuts across the beds of limestone. The course of the vein is N. 50° E. and dip 65° to 80° W. The vein worked was four to six feet wide. Ore mined carried 10 to 12 ounces in silver per ton and 6% to 8% in lead.

Development consists of a vertical shaft 300 feet deep, then a winze from 300-foot level 450 deep to the 750-foot level. There is an extensive amount of underground workings on the property. The mine is said to have produced about \$2,000,000. Idle.

Bibl: State Mineralogist's Reports VIII, p. 226; X, p. 211; XII, p. 24; XV, p. 100-101; XVII, p. 289-290. Mineral Resources West of Rocky Mts., 1876, p. 25. Report of Director of Mint, Precious Metals in U. S. 1883, p. 163. U. S. G. S. Bull. 580 pp. 12-18.

Mineral Hill Group of Mines (Lead-silver). This group comprises 11 claims located on the east slope of the White Mountains, in Sec. 29, T. 8 N., R. 36 E., M. D. B. and M., 17 miles by road northeast of Big Pine. Elevation 6500 feet. Owners, Robert W. Swank and L. Ludwick, of Big Pine, California.

The country rock is limestone, with intrusions of diorite that in places have altered the limestone to a lime-silicate rock. A series of parallel veins occur in the limestone trending north and dipping 30° to 40° east. The ore occurs in these veins as irregular lenses of lead carbonate and galena. The width of ore varies from 12 inches to four feet. The ore that has been sorted out is reported to carry 30% lead and 30 ounces in silver per ton.

Developments consist of a series of short tunnels and shafts. On the west end of this group of claims, ore has been exposed in 8 cross-cut tunnels for a distance of 800 feet. These tunnels vary from 20 to 350 feet in length. The tunnels cut a series of parallel flat-dipping veins from six inches to two feet thick. Two men are employed on development.

Mineral Point Mine (Sanger Mine) (Lead-silver). It is situated on the west slope of the White Mountains, on a ridge two miles south of Black Canyon and 14 miles east of Bishop. Elevation 8200 feet. Owners, Chas. W. Bretz and Flynn Bros., Bishop, California.

Holdings comprise 7 claims, located in Secs. 13, 14, 23, 24, T. 7 S., R. 34 E., M. D. B. and M. The mine was operated under lease and bond by W. A. Sanger and Robert Swank, of Big Pine, in the early part of 1925. It is stated that during their operations 110 tons of ore was shipped, valued at \$7,000. In April, 1925, the Tonopah Dividend

Mining Company, C. N. Miller, president, San Francisco, California, secured a bond and lease on the property and operated the mine from that date until December, 1925, when operations were suspended. During this period 400 tons of ore were shipped from the property, said to have a value of \$60 per ton in lead and silver. This company surrendered its option and the property is now being operated by the owners.

The country rock is limestone and quartzite. The ore occurs as irregular lenses of lead carbonate and galena in the limestone close to the contact of the quartzite. The vein strikes north and dips 40° W. Width varies from two to four feet.

Development consists of a shaft 50 feet deep and a tunnel 100 feet in length, these workings being located on the south slope of the ridge. On the north slope of the hill, at a vertical depth of 100 feet below the above mentioned workings, a tunnel has been driven south 300 feet following a fault fissure. The tunnel intersected an east and west fissure about 280 feet from the portal, which was drifted on for a distance of 100 feet. Some high-grade galena and carbonate ore was found where these two fissures intersected but the lens of ore was small. Four men are employed.

Minneatta Mine. (Lead-silver-zinc). It is located in the Lookout District on the east slope of the Argus Mountains, 28 miles north of Trona and 12 miles east of Darwin. Elevation 3000 feet. Owner, J. J. Gunn, of Independence, California. Under lease to Thomas L. Chapman, Keeler, California.

Development consists of a number of tunnels. Two men are employed.

Bibl: State Mineralogist's Reports X, p. 212; XV, p. 101; XVII, p. 290. R. W. Raymond, Mineral Resources West of the Rocky Mountains, 1876.

Modoc Mine (Lead-silver). It is situated in the Lookout District, on the east slope of the Argus range of mountains, 30 miles north of Trona and two miles north of the Mineatta Mine. Elevation 3500 feet.

Development consists of tunnels; lower tunnel 1200 feet in length. Idle for many years. Production \$1,900,000.

Bibl: State Mineralogist's Reports XII, p. 24; XIII, p. 32; XV, p. 101; XVII, p. 290. Report of Director of Mint, Precious Metals in U. S. 1883, p. 164; 1884, p. 104.

Monster Mine (Lead-silver). It is situated on the east slope of the Inyo Mountains, northwest of Saline Valley.

The orebody occurs as an irregular lens of nearly solid galena, three feet wide. The trend of the vein is northwest. The ore makes in bunches in the limestone but is everywhere associated with quartz although the galena tends to segregate and form pure masses. Country rock is limestone.

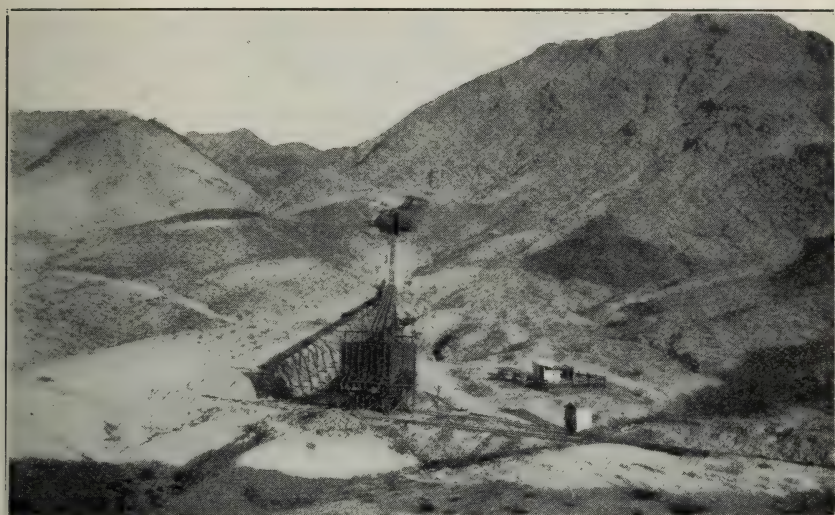
Development: Two tunnels; the upper tunnel is 75 feet in length and the lower 200 feet in length.

Bibl: State Mineralogist's Report XV, p. 101; U. S. G. S. Bull. 540, p. 111.

Montezuma Mine (Lead-silver). It is situated 10 miles southeast of Big Pine, on the western slope of the Inyo Mountains. Elevation 4700 feet. Owner, Montezuma Mining Company, No. 1 Broadway, New York, N. Y. Under lease to Peter Buol, of Los Angeles.

The country rock is limestone and slates which have been greatly shattered and faulted. The ore forms in irregular lenses along a fault between the limestone and clay slates. The ore is argentiferous galena and lead carbonate, in a gangue of iron oxide and decomposed lime. It carries from 12 to 18% lead, 9 to 10% zinc and 10 to 12 ounces in silver per ton.

Development consists of three crosscut tunnels driven northeast to intersect the orebody at different elevations. Lower tunnel is 1400 feet, intermediate 400 feet and upper 200 feet in length. A sulphide orebody in the upper tunnel was worked out in the latter part of 1925



Noonday Mine of Tecopa Consolidated Mining Co., at Tecopa, Inyo County.

and a number of shipments were made to United States Smelting, Refining and Mining Company's smelter at Midvale, Utah. Idle.

Bibl: State Mineralogist's Reports XIII, p. 32; XV, p. 102; XVII, p. 291. Reports of Director of Mint, Precious Metals in U. S. 1883, p. 158; 1884, p. 100. U. S. G. S. Bull. 540, pp. 109, 110.

Nancy Hanks Mine (Lead-silver). It is situated in the Waucoba District 28 miles by road southeast of Big Pine, on the east flank of the Inyo range of mountains. Elevation 6000 feet. Owner, George Warren, of Big Pine, California.

Bibl: State Mineralogist's Reports XV, p. 102; XVII, p. 291.

Noonday and Grant Mines (Lead-silver-zinc). These two properties are situated in the Resting Springs District, nine miles southeast of Tecopa and two miles southeast of the Gunsite Mine. Elevation 2880 feet. Owner, Tecopa Consolidated Mining Company; Dr. L. D.

Godschall, vice president and general manager; L. M. Banks, superintendent, Tecopa, California.

A spur track of the Tonopah and Tidewater Railroad runs from Tecopa to the mine. The company operates its own locomotive for hauling ore from the mines to Tecopa.

The Noonday and Grant mines are located on the same fissure in limestone as the Gunsite and War Eagle mines. The trend of this vein is N. 40° W., dip 45° NE. The width of the orebodies is from two to six feet. The main orebodies occur along a series of parallel north and south fault fractures in dolomitic limestone. The ore is carbonate of lead with some oxidized galena. The ore mined from the Noonday Mine during 1925 and 1926 averaged 15% lead, 6 to 8 ounces in silver, and \$1.50 in gold per ton.

There is a large tonnage of ore in the mine which carries from 4 to 5% lead and 5 ounces in silver per ton. This grade of ore was formerly treated in the company's 100-ton concentration mill located at Tecopa but the mill was not operated during the past two years.

Development consists of an incline shaft sunk on an angle of 45° to a depth of 400 feet. Main tunnel, known as the 200-foot level, is driven south 1800 feet through the hill to the Grant Mine. About 600 feet south of the shaft on this level, a winze has been sunk on an incline to a depth of 600 feet. Ore has been stoped from the 550-foot level to tunnel level. The ore is hoisted from the winze by a 15-h.p. gas engine, then trammed to an ore pocket in the main shaft on tunnel level. The Grant shaft is 175 feet deep sunk on an incline of 50°. Twelve men are employed.

Bibl: State Mineralogist's Reports XV, pp. 103-104; XVII, pp. 291-293.

Opal Mine (Lead-silver). It is situated in the Waucoba District 26 miles southeast of Bishop. Owners, Walter Bird and Russell Steward, Big Pine, California. Idle.

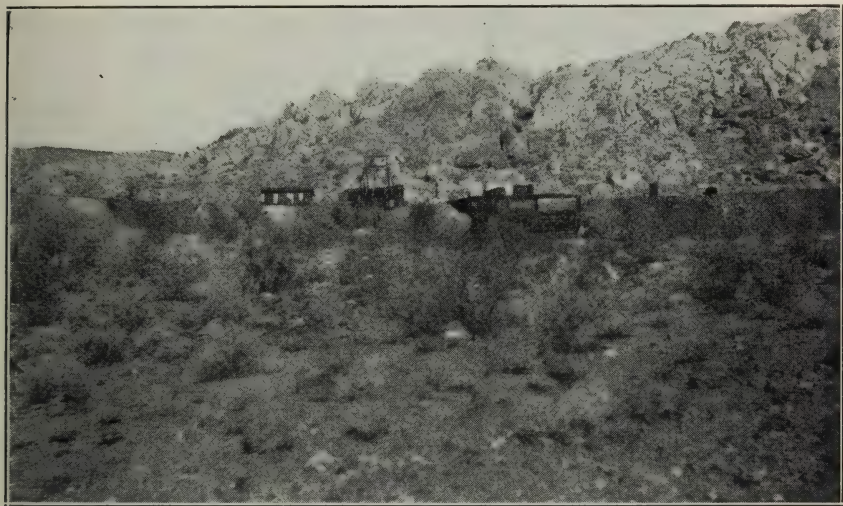
Bibl: State Mineralogist's Reports XV, p. 104; XVII, p. 293.

Ophir Mine. (Lead-silver). It is situated 10 miles northeast of Trona, at the base of the Slate Range. Elevation 2100 feet. Holdings comprise fifteen claims. Owner, Engineers Exploration Company; John W. Kelly, president; John Fox, vice president and general manager; Edith Koons, secretary; C. O. Mittendorf, superintendent. Offices, 718 Hibernia Building, Los Angeles.

The orebody consists of a vein, varying in width from two to 20 feet, in limestone. The vein trends N. 30° W. with a dip 60° to 70° W. and has been developed along its strike for a distance of 1000 feet. The vein material is highly oxidized, containing essentially carbonates of lead. Galena occurs occasionally as bunches in the vein, some zinc carbonate occurs on the footwall of the vein.

The ore being shipped carries 30% lead, 3% zinc, 20% iron, 10% insoluble and 4 to 5 ounces in silver per ton. The present company purchased the property and started operations in February, 1925, and on October 26, 1926, the net smelter returns from ore shipments amounted to \$200,000. The company is shipping 10 cars of ore per month.

Development consists of three shafts and a tunnel 200 feet long. No. 1 shaft is sunk on an incline of 60° following the vein to a depth of 120 feet. No. 2 shaft is located 450 feet north of No. 1 shaft and is sunk on the vein at an angle of 65° to a depth of 230 feet. No. 1 and No. 2 shafts are connected by a drift on the vein on the 100-foot level. The ore-shoot developed in No. 1 and No. 2 shafts trends about 45° north and at a depth of 230 feet No. 2 shaft went through the orebody. On 230-foot level a drift has been driven on the vein to the north to the end of the orebody, then a winze 75 feet deep sunk in the ore. From the bottom of this winze, there is a drift north in ore for 100 feet, at which point a winze is sunk to a depth of 45 feet. The orebody to the north appears to be increasing in width, the maximum width in places being about 20 feet. A vertical shaft is being sunk 750 feet north of No. 2 shaft and it is estimated that this shaft will intersect the orebody at a depth of 500 feet. The company is planning to install



No. 2 Shaft, Ophir Mine, Slate Range, Inyo County.
Owner, Engineers Exploration Company.

a 100-ton concentration plant to treat the low-grade ore that has been developed, which is stated to carry from 8 to 12% lead. Water for domestic purposes is secured from springs in the Argus Range, a distance of $6\frac{1}{2}$ miles west of the mine. It is planned to secure water for milling operations from Well No. 6, owned by the Trona Corporation, which is located 8500 feet southwest of the mine.

Equipment consists of 60-h.p. gas engine hoist, located at No. 3 shaft, and 15-h.p. gas engine hoist at No. 2 shaft; 300-cu. ft. Ingersoll-Rand compressor. Thirty men are employed.

Bibl: State Mineralogist's Report XV, p. 105.

Paddy Pride Mine (Lead-silver). It is situated nine miles west of Zabriskie, a station on the Tonopah and Tidewater Railroad in limestone hills, at the southern end of Funeral Range.

Holdings consist of five claims. Owner, Paddy Pride Silver Mining Company. John T. Overburg, president, Tecopa, California.

The ore occurs as irregular lenticular deposits of carbonate of lead in limestone. The general trend of the vein is northwest, dip 60 to 70° southwest. The vein varies in width from four to eight feet.



Workings along outcrop of Stuart Wonder Vein, Panamint District, Inyo County. Panamint Mining Company, Owner.

Development consists of two tunnels, one 150 feet long, the other approximately 200 feet in length. Ore shipped from the property in 1919 was reported to carry 40% lead and 24 ounces silver per ton. Idle.

Bibl: State Mineralogist's Report XVII, p. 294.

Panamint Mines (Silver). This group of mines is situated in the Panamint District, in Surprise Canyon, on the west slope of the Panamint range of mountains, 10 miles northeast of Ballarat. Elevation 6000 to 7500 feet.

Holdings comprise 11 patented claims and 7 claims held by location. Owner, Panamint Mining Company. E. J. Lewis, president; W. L. Seeley, manager, Trona, California.

The country rock in the neighborhood of the mines consists of limestone, slates, schist and granite. The vein system comprises a series of parallel quartz veins, 6 to 8 feet wide, that trend northeast and dip 60° to 70° to the northwest. The principal veins are known as Wyoming, Tom Boy and Stuart Wonder. These veins cut both the schist and limestone but the principal mineralization occurs in a belt of limestone, one-quarter to one-half mile wide, that trends northwest and southeast. The vein quartz is mineralized with tetrahedrite and stained with bromides of silver, azurite and malachite.

Development: At an elevation of 6150 feet on the south side of Surprise Canyon there is a crosscut tunnel 2300 feet long, about 1000 feet vertically below the outcrop of the Wyoming vein. Operations were suspended before reaching the vein. At an elevation of 7100 feet, a tunnel known as the Wyoming workings was driven as a crosscut south 100 feet to the vein, and a drift run southwest 200 feet. At 150 feet south of the crosscut there is a raise to the surface, a distance of 100 feet, and a winze from this tunnel level 200 feet on the vein.

On the opposite side of the ridge, southwest of these workings, are a number of tunnels driven on the Wyoming vein at different elevations. A considerable amount of stoping has been done from these workings. The ore, formerly treated in a 20-stamp mill, was transported by aerial tramway from the Wyoming workings to Panamint City. The district was discovered in 1873 and the greatest amount of activity was from 1873 to 1880 when Senator Jones and Senator Stuart, of Nevada, were interested in the development of the different mines in the district. The property was operated by the present company from June 1, 1925, until June 1, 1926, when operations were suspended. Idle.

Pennsylvania Mine (Lead-silver). It is situated in Swansea District at the old camp of Swansea, 3½ miles northwest of Keeler. Elevation 4000 feet. Owner, J. D. Leary and Associates, of Lone Pine. Idle.

Bibl: State Mineralogist's Report XVII, p. 293.

Pete Smith Mine (Lead-silver). It is situated 4½ miles east of Keeler, on the west slope of the Inyo Range. Elevation 4850 feet. Owner, Calavada Mining Company. Mr. Spaulding, president; Paul Watterson, secretary; William Skinner, vice president, Lone Pine, California.

Holdings comprise 60 claims. The principal development work is confined to the Waverly group of claims. The ore occurs as irregular lenses of lead carbonate and galena in a belt of thin-bedded limestones that occur east of a belt of thin-bedded shales, which strike N. 30° W.

and dip 40° W. Near the shaft is a monzonite intrusion in the limestone.

Development consists of an incline shaft sunk to a depth of 150 feet on a vein that strikes N. 30° W. and conforms to the bedding of the limestone. The orebody is developed on three levels at 50, 100 and 150 feet. During 1925, 360 tons of ore was shipped from the property. Equipment consists of 6-h.p. gas engine hoist. Four men are employed.

Pierson Mining Company's Group of Mines (Silver-lead). This group of mines is located on the west flank of the Inyo Range, seven miles east of Independence and three miles northeast of Kearsarge, a station on the California and Nevada Railroad. Elevation 4450 feet.

Holdings comprise 30 claims. Owner, R. B. Whiteside, of Duluth, Minnesota.

The formation is thin-bedded Carboniferous limestone. The limestone beds strike north and dip 45° west. The vein strikes north and dips 45° west, conforming to the beds of limestone. The width of the vein is from two to four feet. The ore occurs as an irregular lens of lead carbonate with occasional bunches of galena.

Development consists of a crosscut tunnel driven N. 70° E. 3000 feet. The vein which outcrops strongly on the surface was cut at 700 feet from the portal, but at this point the vein was only a narrow seam, showing no ore. The contact between granite and limestone was cut at 2800 feet from the portal, but no ore was found on this contact. Above this tunnel, a shaft was sunk to a depth of 50 feet and the orebody drifted on several hundred feet on the 50-foot level. Ore stopped from these workings carried 20% lead and 10 to 12 ounces in silver per ton.

Equipment consists of a 200-h.p. Diesel engine connected to a 1000-cu. ft. Sullivan compressor; drill sharpener; 3½-ton storage battery locomotive used for haulage.

Operations were suspended in June, 1926, as no orebodies of any extent had been developed.

Pine Tree Group of Mines (Lead-silver). This group comprises six claims located on the east flank of the Inyo Range, 15 miles east of Big Pine. Owner, O. Bertenshaw, Bishop, California.

The ore occurs as lead carbonate and galena in limestone. Idle.

Promontory Mine (Lead-silver). It is located in the Darwin District, 1½ miles south of Darwin. Elevation 5000 feet. Owner, Darwin Development Company, New York.

The ore consists of lead carbonate and galena in limestone. The vein strikes N. 20° W. and dips 30° W.

Development consists of an incline shaft sunk on the vein to a depth of 320 feet. Idle.

Bibl: State Mineralogist's Report XV, pp. 105-106.

Raven Mine (Lead-silver). It is located in the Ubehebe District, 60 miles southwest of Bonnie Claire, Nevada, and five miles north of Dodds Springs. Elevation 3800 feet. A. Farrington, of Big Pine, owner.

Ore occurs as lead carbonate and galena in limestone.

Development consists of 2000 feet of tunnels, mostly crosscuts. Idle.

Bibl: State Mineralogist's Reports XV, p. 106; XVII, p. 293.

Redwing Mine (Lead-zinc). It is situated in Resting Springs District, four miles northeast of Shoshone, on the west slope of Resting Springs Mountains. Idle. Owner, R. J. Fairbanks, of Shoshone, California.

Bibl: State Mineralogist's Report XV, p. 106.

Reed Flat Mine (Lead-silver). It is situated on the western slope of the White Mountains, two miles south of Reed Flat and 16 miles by road via Black Canyon east of Bishop. Elevation 9000 feet to 10,000 feet. Owner, Judge J. O. Ray and Fred Smith, of Bishop, California. Under option to Mexican Mining Company, Virginia City, Nevada.

Holdings comprise eight claims and 40-acre mill site at Black Canyon Spring.

The formation is limestone and quartzite. The ore occurs as irregular lenses of lead carbonate and galena, along the contact of quartzite and limestone and in places is entirely inclosed in the limestone. The ore developed carries 12 ounces in silver per ton, 8% lead. Ore sorted to carry 50% lead and 50 ounces in silver per ton.

Development consists of three tunnels and open-cuts. The main working tunnel is driven S. 50° E. 800 feet with 1000 feet of drifts and crosscuts. Four men are employed.

Royal Mine (Lead-silver-zinc). It is situated in the Cerro Gordo District, one mile north of Cerro Gordo Mine and 8 miles east of Keeler. Elevation 8400 feet to 9000 feet. Mrs. R. C. Spear, Lone Pine, owner. Holdings comprise 7 claims.

The formation consists principally of limestone, with a belt of slates on the west slope of the ridge. On the Lead King and Lead Prince claims, there are three intrusions of diorite porphyry in the limestone that trends northwest. On the east slope of the ridge there is a belt of white marble that trends with the ridge. This belt of marble is about 300 feet wide. Three parallel veins occur in the limestone and strike N. 30° W. and dip 70° W. These veins vary in width from 12 inches to three feet. Average width is about 18 inches. The ore occurs as lead carbonate with occasional bunches of galena and zinc carbonate (smithsonite). The principal production of lead ore has come from a 150-foot shaft on the Lead Queen claim, while the zinc production has come from the workings on the Lead King and Lead Prince claims. The principal development consists of a crosscut tunnel on the Emperor claim, located on the west slope of the ridge, and an incline shaft 150 feet deep, located on the Lead Queen claim, which is on the east crest of the ridge, 3800 feet southwest of the Emperor tunnel. At an elevation of 8400 feet, the Emperor tunnel is driven east 900 feet in limestone. A fault which strikes north and dips 70° W. was cut in this tunnel 700 feet from the portal. This fault was drifted on 100 feet south but no ore was developed. There are a number of tunnels and open-cuts on the several veins on the slope of the ridge above this tunnel, all of which produced some lead and zinc ore. The Lead Queen shaft was sunk on an incline of 50° to the 50-foot level. Where the vein straightened from this level to the 100-foot level, the shaft has an inclination of 75°. On the 100-foot level the vein was drifted on south 175 feet. At 100 feet south of the shaft a winze has been sunk on the vein to a depth of 50 feet, with a drift south 150 feet.

The vein developed in these workings varies from 18 inches to three feet. The ore is lead carbonate and galena with some high-grade zinc carbonate on the footwall of the vein. The lead ore shipped from these workings carried 20% to 29% lead and 26 ounces in silver per ton. It is stated that 46,000 pounds of zinc ore was shipped from the property that averaged 39.2% zinc.

The mine was under production from 1913 to January, 1917. Idle.

Bibl: State Mineralogist's Reports XV, p. 106; XVII, p. 294.

Sam Lucas Mine (Lead-silver). It is situated in the Cerro Gordo District, 9 miles east of Keeler, two miles east of the Cerro Gordo Mine. Elevation 7500 feet. Under option to Paul Watterson and associates, Keeler, California. Holdings comprise 7 claims.

Development consists of 1500 feet of tunnels and drifts. A vein 4 to 6 feet wide occurs in limestone. Ore is reported to carry 2% lead, 2% copper, 20 ounces silver per ton and .05 ounces gold per ton. Idle.

San Pedro Mine (Lead-silver). It comprises one claim situated on the east slope of the White Mountains, 16 miles southeast of Big Pine. Elevation 7700 feet. Owner, W. A. Coulter, San Pedro, California.

The ore occurs as galena in a quartz vein that strikes N. 30° W. and dips 45° E., in slate and limestone.

Development consists of several shafts and short tunnels. Idle.

Santa Rosa Mine (Lead-silver). It is situated in the Lee District east of the Cerro Gordo Mine and 26 miles by road from Keeler. Elevation 7000 feet. Owner, Santa Rosa Mining Company. A. T. Smith, secretary, Syndicate Building, Oakland, California. Under lease to J. R. LeCyr, Keeler, California. Holdings comprise 113 acres of patented land.

The country rock is limestone, intruded by basalt and andesite porphyry dikes. The ore is deposited in veins along the limestone-igneous contacts. There are two systems of veins; a series of parallel veins trend east and dip 35° S. and a series that trend north and dip 38° W. The veins occur in a mineralized zone 800 feet wide that trends north. There are 14 parallel veins within this zone which have all been extensively worked by shafts and tunnels along the outcrops.

Present development work is confined to the east veins on the south side of Santa Rosa Canyon. On the footwall vein of this mineralized zone, an incline shaft has been sunk to a depth of 310 feet, on an inclination of 35°. Drifts are driven on the vein, east and west on the 130-foot level, 200-foot level and the 300-foot level. The orebody developed on the 130-foot level was 175 feet long and from four to six feet wide. Some small lenses of ore are being worked on the 200- and 300-foot levels. On the 200-foot level the vein is cut by a basalt dike that is 6 feet wide and trends N. 20° E. and dips 80° W. Lead carbonate and galena occur on both sides of the dike. An andesitic dike cuts off the orebody on this level about 160 feet south of the shaft. This dike strikes northwest, is four feet wide and is vertical. The ore mined is lead carbonate and galena, said to carry 15% to 30% lead and from 15 to 30 ounces of silver per ton. Ore is hauled by trucks to Keeler at a cost of \$4.50 per ton. This footwall vein is reported to have pro-

duced \$300,000 to a depth of 300 feet, with a lateral development of 200 feet on the different levels. On the north side of the canyon the veins that trend north are developed by a tunnel 300 feet in length, with crosscuts, drifts and raises amounting to 600 feet. Equipment



Santa Rosa Mine, Cerro Gordo District, Inyo County.

consists of jig-back tramway from bins at the shaft to loading bins. There is a 15-h.p. gas engine hoist. Six men are employed.

Bibl: State Mineralogist's Reports XV, p. 108; XVII, p. 294.

Silver Button and Shamrock Group of Mines (Lead-silver). This group comprises 13 claims located three miles southwest of Darwin, on the west slope of the Argus Range. Elevation 5000 feet.

Development consists of a 50-foot shaft and 20-foot tunnel. Two men are employed. Owner, Corbett Blank, Darwin, California.

Silver King Mine (Lead-silver). It is situated in Sec. 8, T. 24 S., R. 43 E., M. D. B. and M., 9 miles northeast of Trona, on the west slope of Slate Range. Elevation 3600 feet. Owner, Reorganized Silver King Mining Company. Shand Smith, president; Miss Cobb, secretary; A. L. James, superintendent, Reno, Nevada.

The country rock is limestone, granodiorite and quartzite. The ore is lead carbonate and galena occurring in a vein in limestone that trends N. 40° W. and dips 40° NE. A tunnel has been driven north 800 feet to intersect ore showings that outcrop on the north end of the property.

Equipment consists of 2-drill compressor driven by a 25-h.p. gas engine. Four men are employed.

Silver Peak Mine (Hemlock Group) (Silver). It is located in the Panamint District on the south side of Surprise Canyon, on the west slope of the Panamint Range, 12 miles northeast of Ballarat. Elevation 7350 feet. Owner, A. D. Myers, of Los Angeles.

A vein of quartz 6 to 8 feet wide occurs in limestone, strikes northeast and dips 70° NW. The vein has been developed by a number of tunnels driven at different elevations. The lower tunnel is a crosscut driven 150 feet to the vein, with drifts on the vein for a distance of 500 feet. Idle.

Silver Reef Mine (Lead-silver). It is located in the South Park District, six miles east of Ballarat, near the summit of Panamint Range. Idle.

Bibl: State Mineralogist's Reports XV, p. 108; XVII, p. 294.

Silver Rule Mine (Lead-silver-zinc). It is situated in the Resting Springs District, on the southwest slope of the Kingston Range, 17 miles east of Morrison's siding, on the Tonopah and Tidewater Railroad. Holdings comprise 12 claims. Owner, Pacific Lead and Silver Mining Company, 711 Sun Building, Los Angeles. A. J. Jarmuth, president; C. A. Malburg, superintendent.

The ore occurs as irregular lenses of lead carbonate and galena along a fissure in limestone. The vein strikes northwest and dips 75° N. The width of ore developed is from 3 to 15 feet. The lead ore carries values in silver. The ore is reported to contain 10 to 20 ounces in silver per ton, 20 to 40% lead and 7 to 10% zinc.

Development consists of four tunnels. The upper tunnel (No. 1) is 220 feet in length, and 75 feet vertically below is No. 2 tunnel, 400 feet in length, with a raise from No. 2 in ore to No. 1. At 560 feet vertically below No. 2, a new tunnel is being driven. This tunnel is driven as a crosscut 300 feet southwest, with a drift 200 feet west on a fracture in the limestone. At an elevation of 3410 feet (No. 4) lower working tunnel is driven south 300 feet. Six men are employed.

Bibl: State Mineralogist's Reports XV, p. 104; XVII, pp. 365-366.

Silver Spoon Mine (Lead-zinc). It is situated two miles southeast of Darwin and northwest of the Columbia Mine, on the west slope of

the Argus Range. Holdings consist of ten claims. Owner, Dan Gillen, Darwin, California.

Ore occurs as lead carbonate and galena in limestone. Development consists of a shaft 60 feet deep. Two men are employed.

Slate Range Mine (Lead-silver-gold and copper). It is situated in the Slate Range, 8 miles northeast of Trona. Elevation 4000 feet. Owner, Slate Range Consolidated Mining Company. T. A. Wells, president, Bakersfield, California. Holdings comprise three patented claims known as the Copper Queen Group.

The country rock is limestone. The ore occurs as lead carbonate, galena and copper sulphides, carrying gold and silver values. The production in 1918 was 1,331,440 pounds of lead, 90,124 pounds of copper, 1786 ounces of gold and 64,389 ounces of silver. The mine was operated continuously from 1917 to 1921 when operations were suspended.

Development consists of a shaft 700 feet deep. There is a 50-ton flotation plant on the property containing crusher, ball mills, Overstrom concentrators and K and K flotation machines. Idle.

Summit Mine (Lead-silver). It is situated on the east slope of the White Mountains, 18 miles east of Big Pine.

The ore occurs as lead carbonate and galena in limestone. Owner, O. Bestenshaw, Bishop, California. Idle.

Swansea Mine (Lead-silver). It is situated in the Swansea Mining District, on the west flank of the Inyo Range, 2½ miles north of Keeler. Elevation 4550 feet. The mine was located in July, 1926, by J. D. Leary and purchased by W. F. Whiteside, Duluth, Minnesota.

The country rock is limestone and quartzite, with diorite porphyry intrusions. In the vicinity of the shaft the limestone has been altered to a lime-silicate rock. The ore occurs as lead carbonate, zinc carbonate and galena along the contact of quartzite and limestone. The vein strikes N. 40° W. and dips 45° NE., and is 4 to 6 feet wide. The footwall of the vein is limestone, with quartzite hanging wall.

Development consists of an incline shaft 70 feet deep and a level at 60 feet, with drifts north and south on the vein. Equipment: Ingersoll-Rand portable compressor, tugger hoist and air drills. Six men are employed.

Swansea Chief Mine (Silver-lead). It is situated in the Swansea District four miles northeast of Keeler, on the southwest slope of the Inyo Range. Elevation 4600 feet. Idle.

Bibl: State Mineralogist's Report XVII, p. 294.

Ubehebe Mine (Lead-silver). It is situated in the Ubehebe District, 52 miles by road southwest of Bonnie Claire, Nevada. Elevation 3930 feet. Idle. Owner, A. Farrington, Bishop, California.

Bibl: State Mineralogist's Reports XI, p. 109; XVII, p. 294.

Union Mine (Lead-silver-gold). This property is described under gold mines in Report Fifteen of the State Mineralogist, p. 80, but the principal values of the ore are in lead and silver. The mine is situated in the Russ Mining District, Sec. 14, T. 14 S., R. 30 E., M. D. B. and M.,

three miles northwest of Owenyo, a station on the Southern Pacific Railroad, near the base of the Inyo Mountains. Elevation 5500 feet. Owner, Mt. Whitney Union Mining Company. P. E. Watterson, president; A. G. Mahan, secretary; E. J. Carillo, managing director. Holdings comprise 7 claims, five of which are on the vein.

A well-defined quartz vein, averaging six feet in width, cuts the Carboniferous limestones and calcareous slates. The vein trends N. 70° E. and dips 65° N., and can be traced on the surface in a bold outcrop for a distance of 6000 feet. The vein quartz is mineralized with galena and in places shows lenses of lead carbonate ore. Average value of the ore is stated to be \$3 in gold, 6% lead and 7 ounces in silver.

On the Little Bill claim, which is located on the east end of the property, a shaft has been sunk on a lenticular body of lead carbonate and galena that occurs in the vein where it cuts massive-bedded limestone. In the vicinity of the shaft there is an intrusion of quartz monzonite



Outcrop of Union Vein, Union Mine, Owenyo, Inyo County.
Mt. Whitney-Union Mining Company, owner.

that has metamorphosed the limestone to a lime-silicate rock. The ore is massive galena, lead carbonate and shows some ruby silver, also chalcopyrite and malachite. The average grade of this ore will carry 30% lead, 24 ounces in silver per ton, 0.24 ounces in gold. The greatest vertical depth below the outcrop is 1900 feet.

Development consists of five tunnels, with three driven on the vein at different elevations, totaling approximately 2000 feet. The principal ore development has been on No. 1, No. 2 and No. 3 tunnels. No. 3 tunnel is 600 feet vertically above the lower tunnel and is driven east 315 feet. No. 2 tunnel is 200 feet vertically above No. 3 and is driven east on the vein 600 feet. No. 1 tunnel is 200 feet vertically above No. 2 tunnel and is driven east 600 feet. It is 400 feet vertically below the apex of the outcrop.

Development on Little Bill claim consists of a shaft 75 feet deep.

Equipment consists of two portable compressors and a 15-h.p. hoist. There is a plentiful supply of water on the property for mining and milling purposes. Eight men are employed on development.

Utacala Mine (Zinc). It is situated in the Darwin District, on the north slope of the Argus Range, 9 miles east of Darwin. Elevation 4000 feet. Owner, American Metals, Inc. C. H. Lord, president, Darwin, California.

The country rock is limestone and quartz monzonite. The ore is deposited as zinc carbonate and sphalerite in the limestone. The ore was calcined below the mine and then hauled 34 miles to Keeler. During 1918 this mine was one of the largest producers of zinc ore in Inyo County. Development consists of five tunnels. Idle.

Bibl: State Mineralogist's Report XVII, pp. 294-295.

Ventura Mine (Silver Reef Group) (Lead-silver). It comprises 16 claims, located 7 miles east of Keeler, on the west slope of the Inyo Range, $1\frac{1}{2}$ miles southwest of the Cerro Gordo Mine. Elevation 7050 feet. Owners, Chas. Baagoe and H. C. Eldridge, Los Angeles.

Two well-defined veins occur in limestone, known as the Wheeler and Main veins. The Wheeler vein strikes N. 30° W. and dips 70° to 80° W. The width is two to five feet. The main vein strikes N. 20° E. and dips 80° E; width two to four feet. These two veins intersect on a ridge north of the Ventura shaft and to the west of this intersection is an intrusive quartz monzonite which has metamorphosed the beds of limestone a great distance from its contact. The ore occurs as irregular lenses of lead carbonate and galena in well-defined fissures in the lime-silicate rocks.

Developments consist of a shaft 150 feet deep, and four tunnels 100 to 200 feet in length. The main working tunnel (lower) is driven northeast 300 feet. Several winzes have been sunk from this level to a depth of 50 feet in the ore. During 1926 a carload of ore was shipped from the mine carrying 12 ounces in silver per ton, 33% lead and 1.8% zinc. Shipments of ore in 1925 carried 13 ounces silver per ton and 42.7% lead. The reported production of the property is \$100,000. Two men are employed.

Bibl: State Mineralogist's Reports XV, p. 110; XVII, p. 295.
U. S. G. S. Professional Paper 110, p. 117.

War Eagle Mine (Lead-silver-zinc). It is situated in the Resting Springs District on the western slope of the Nopah range of mountains, 9 miles southeast of Tecopa and one mile south of the Grant mine. Elevation 2600 feet. Owner, Tecopa Consolidated Mining Company. Dr. L. D. Godschall, vice president and general manager; L. M. Banks, superintendent, Tecopa, California.

The deposit is a continuation of the Gunsite-Noonday vein. The strike is N. 40° W. and dip 50° NE. The orebodies developed are formed along a series of parallel north and south fault fractures in dolomitic limestone. The ore is lead carbonate with some unoxidized galena, with values in gold running as high as 0.60 ounces per ton. The average value of ore shipments carried 12 to 15% lead, 3 ounces silver per ton and 0.51 ounces gold per ton, magnesia 10 to 15%; lime 20%.

Development consists of a crosscut tunnel driven N. 60° E. 450 feet to the vein, with a drift south 400 feet on the vein, and north 150 feet. At 100 feet south of the crosscut tunnel, a winze has been sunk on the vein to a depth of 100 feet, with levels at 50 and 100 feet. The lateral development on the vein on these levels is about 300 feet. The ore-shoot developed was 100 feet in length and from two to six feet in width, stoped from tunnel level to surface.

Equipment consists of 40-h.p. Fairbanks-Morse Diesel engine, 9"x8" Ingersoll-Rand compressor; nine ore bins having a capacity of 100 tons and loading bins also of 100-ton capacity. Ore is hauled by trucks to the railroad, a distance of 1¼ miles. Six men are employed.

Wonder Mine. (Lead-silver-copper). It is situated in the Darwin District, 1½ miles east of Darwin. Elevation 4700 feet. Owner, Richard Wallace, Darwin, California. Holdings comprise 8 claims.

The ore occurs as irregular lenses of lead carbonate and galena in limestone. Copper carbonates and chalcopyrite are found along an intrusion of diorite porphyry on the contact. The lead ores occur along a vein that trends northwest and dips 45° west. The vein filling of the fissure is coarse calcite with some coarsely crystalline fluorite. Galena ore occurs with calcite and fluorite as a gangue.

Development consists of two incline shafts; No. 1 shaft being 225 feet deep and No. 2 shaft 100 feet deep. There are a number of tunnels and shafts on the copper-bearing vein. Equipment consists of 15-h.p. gas engine hoist and blacksmith shop.

LEADFIELD DISTRICT.

The Leadfield District is located in Lost Valley in T. 12 S., R. 45 E., M. D. B. & M., in the Grapevine Mountains of the Amargosa Range in Inyo County, 22 miles westerly from Beatty, Nevada. Elevation 3950 to 5200 feet.

General History.

Lead-silver ore was first discovered in this region in 1905 and a number of claims located by Barney McCann and Seaman on ground which is now known as the Sunrise group of claims and it is reported that some ore was sorted, but it was found to be too low in silver and lead content to pack out, as at this time there was no wagon road to the district. In March, 1924, Ben Chambers and F. J. Metz located 16 claims in the district which were acquired in July, 1925, by The Western Lead Mines Company, incorporated under the laws of Nevada.

Accessibility and Transportation.

The Leadfield District is reached by automobile road from Beatty, Nevada, a station on the Tonopah and Tidewater Railroad, over 8 miles of Boundary Canyon Road, then over 15 miles of new road recently completed by The Western Lead Mines Company, at a reported cost of \$60,000. The district can also be reached by automobile road from Los Angeles, by way of Mojave, Darwin and Death Valley, Stovepipe Wells and Titus Canyon. This latter route is difficult due to excessive grades and rough travel over washes.

Topography and Geography.

The trend of the Amargosa Range of mountains is N. 40° W., and the crest of the range is from 5000 to 7000 feet above Death Valley. Its southwestern slope is steep and cut with deep canyons, set with numerous rugged peaks and pinnacles.

The ridge culminates near its north end in Grapevine Peak, 8700 feet above sea-level. Titus Canyon cuts through the Grapevine Mountains in a southerly direction and is only 40 feet wide. From it, rocks rise sheer 200 feet while the slope of the ridges 2000 feet above is very steep. The canyon walls to a height of 40 feet are water polished. The crest of the Amargosa Range above 6000 feet, at a distance of 8 miles northwest and southeast of Grapevine Peak, is partly covered by a sparse growth of piñon and juniper.

Water.

The water supply for camp and mining purposes is secured from several springs in the vicinity of Titus Canyon. The principal supply at present is secured from a spring in Titus Canyon, two miles west of the camp of Leadfield. Elevation of this spring is 3175 feet, being 900 feet in elevation below the camp. The present flow of this spring is 25 gallons per minute. The spring is being developed by the company by driving a tunnel and the possibilities seem favorable for an increase in the supply. In Welsh Canyon, about 1½ miles southeast of the camp, is a spring reported to flow 500 gallons per 24 hours. There is another spring about one quarter of a mile east of the camp that supplies sufficient water for camp uses. Water can also be secured from Grapevine Spring, a distance of about 8 miles, which is reported to have a considerable flow.

General Geology.

The geology of this region is described by S. H. Ball, in Bulletin 308, of the U. S. Geological Survey, also in the immediate vicinity of Leadfield, by Prof. Bruce Clark, of the University of California, in a special report for the Western Lead Mines Company. The formations in the vicinity of Titus Canyon are limestone, quartzite and flows of rhyolite, with small amounts of andesite and tuffs. The limestone is classified as Pogonip limestone, dark gray, medium-grained limestone of the Ordovician age. The quartzite is classified as Eureka (Ordovician) quartzite, and is pink and rather pure quartz of medium grain. The flows of lava are chiefly Eocene rhyolite and small amounts of andesite. The Pogonip limestone extends from Keane Springs northwestward to Grapevine Canyon. It also covers a large area north of Grapevine Springs and a smaller area east of Cave Rock Spring and an area four miles east of boundary post No. 94. In the large area north of Keane Spring from 2000 to 3000 feet of limestone is exposed. Calcite veinlets occur throughout the limestone mass and in the Titus Canyon, areas of coarse white calcite blotch the limestone. The Eureka quartzite overlies the Pogonip limestone near Boundary Canyon and is estimated to be about 800 feet thick. It is well exposed at Day Light Springs, northwest of Thimble Peak and on the ridge southeast of Welsh Canyon, where it has a thickness of about 600 feet. There are

extensive flows of rhyolite northeast of Titus Canyon, interbedded in which are beds and lenses of red, white and greenish rhyolite tuff.

S. H. Ball states that the calcite veins in the limestone in the vicinity of Titus Canyon are of two ages, the older are formed of white crystalline calcite, much of which is coarsely granular; the younger veins of banded yellow-brown calcite are still forming.

Ore Deposits.

The main locations made by the Western Lead Mines Company lie southwest of Chambers Canyon along a belt of limestone that strikes N. 30° W. The limestone is folded and the beds strike east and dip 60° north. At different points for a distance of about two miles galena occurs disseminated in the hard blue limestone and along certain bedding planes of the limestone replacing the calcite. The principal



Leadfield Carbonate Mine at Leadfield, Inyo County.

mineralization occurs where north and south fractures intersect the bedding planes of the limestone.

Developments.

The principal development work within the district has been on the March Storm group of claims being operated by the Western Lead Mines Company.

Leadfield Carbonate Mines Company Group, W. E. Staunton, president; Fred Berry, secretary. This group comprises four claims known as Quail Nest group, located on the east side of Titus Canyon, about one mile north of Leadfield. Elevation 3750 feet.

In a small butte of limestone that rises above the floor of the canyon and appears to be detached from the main belt of limestone, there is a well-defined fissure that strikes N. 70° E. and dips 65° south. A tunnel is being driven S. 70° W. on this fissure, the present length of the

tunnel being 40 feet. The width of this fissure is four feet and it is partly filled with lead carbonate ore. Samples taken are reported to assay, lead 18%, silver 7 ounces. Above this tunnel on the surface, ore is exposed in several open cuts for a distance of about 200 feet southwest of the tunnel. This is the only occurrence of carbonate ore so far found in the district.

Leadfield Consolidated Mines Company Group. David Staunton, president; Hugh Collins, secretary; William Lawson, treasurer, Tonopah, Nevada. This company controls five claims known as Sand Top No. 1, No. 2, No. 3, No. 4, No. 5, located one-half mile southeast of Leadfield. Some surface showings of galena occur. The company is sinking a shaft.

Leadfield New Road Mining Company Group, W. L. Frick, president; W. F. Stoneback, W. E. Staunton and C. H. Coblicke, Oakland, California. Offices, 1104 Hollingsworth Building, Los Angeles.

Holdings of the company comprise New Road, Forty-nine, Pittsburg, Sixty-three Claims and also the Burr-Welsh group, comprising Daisy No. 1, No. 2 and No. 3.

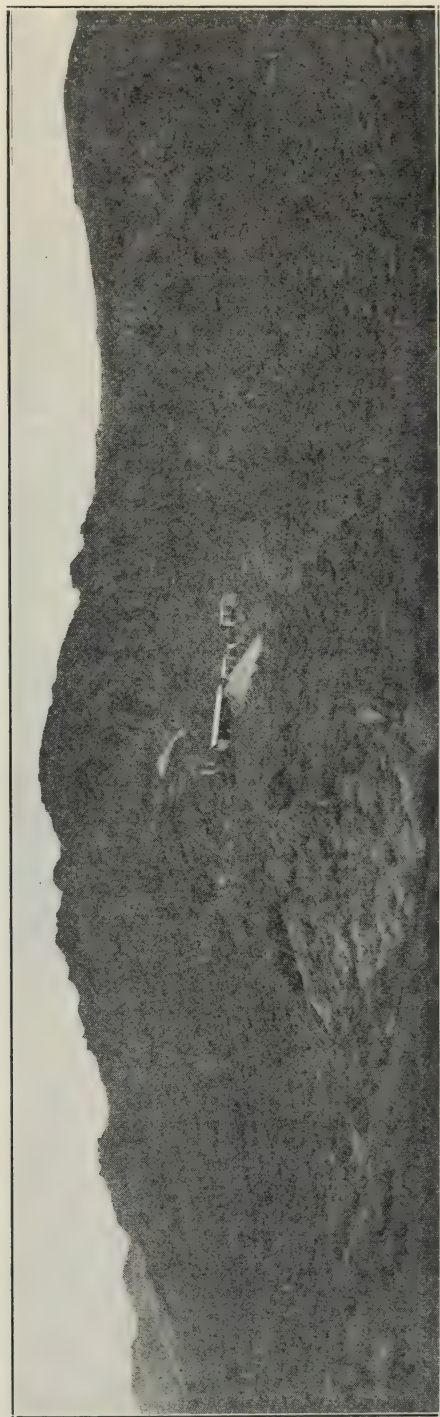
This group is located about two miles southeast of Leadfield near the head of Chambers Canyon.

Ore croppings show on the surface to the northeast of the canyon for a distance of several hundred feet. Galena occurs on the bedding planes of the limestone in yellow-brownish calcite. An opencut above the road exposes 20 feet of limestone mineralized with galena. Samples taken from this cut are reported to assay lead 15% to 20%, silver, 4 ounces. The strike of the ore fissure is N. 30° W. and dip 60° NE. This fissure cuts across the bedding planes of the limestone.

About 100 feet below the croppings two crosscut tunnels are being driven east to cut the ore fissures exposed on the surface. The ore exposures on this group of claims are extensive and by far the best in the district. South of these claims on the Burr-Welsh group, elevation 4500 feet, on a series of north and south fissures, some galena is exposed in open-cuts and an old shaft 50 feet deep. Some of the fissures show copper sulphides associated with galena. It is reported that samples of ore taken from these claims assayed 30 ounces in silver.

An incline shaft is being sunk on a belt of lime shale, near a contact of massive limestone.

Leadfield Bonanza Mining Company Group, David Staunton, president; W. E. Stoneback, secretary; Earl Boardman, treasurer, San Francisco, California. This company owns a group of claims known as the Cadalack group, which comprise Cadalack, Grand Central, Bush Street, South Dip, Leaden Sky and Silver King. They are located one mile southeast of Leadfield on the south side of Welsh Canyon. Elevation 4400 feet. Ore occurs on the north and south fissures that intersect the bedding planes of the limestone which strikes east and dips north 60°. Galena occurs disseminated in the limestone and as replacement of yellow-brown calcite along the bedding planes. Ore showings on Grand Central claim are three to four feet wide. Reported to assay zinc, 15%, lead, 7%, silver, 2.8 ounces, this being zinc carbonate ore with some galena.



Workings on Western Lead Mines at Leadfield, Inyo County.

On Cadalack claim above the tunnel, three to four feet of ore occurs on the bedding plane of the limestone. Vein matter is yellow-brown calcite, showing galena and red lead oxide. A crosscut tunnel is being driven southwest to intersect a north and south fissure. On the South Dip and Leaden Sky claims are some exposures showing galena.

Western Lead Mines.

March Storm Group. This group is being developed by the Western Lead Mines Company, C. C. Julian, president; Jacob Berger, vice president and manager; W. E. Staunton, secretary. Offices, Los Angeles, California. The group comprises 16 claims. On March Storm claims No. 1, No. 2 and No. 3, galena is disseminated in gray limestone. It also occurs along bedding planes of the limestone replacing the calcite veinlets. The principal ore showings are exposed by open-cuts and shallow prospect holes above No. 1 and No. 2 tunnels. For a distance of about 60 feet in a northerly direction, galena is disseminated throughout the limestone at intervals. Also the occurrence of galena was noted on Joplin No. 1 and No. 2 claims and some ore is exposed on the St. Louis, St. Francis and Inyo lead claims, near the Eureka quartzite which overlies the limestone.

Workings: No. 1 or Clark tunnel is driven S. 60° W., 200 feet, at an elevation of 4100 feet. No ore was developed in this tunnel. About 50 feet above this tunnel in an open-cut galena occurs in the limestone for a width of six feet. Samples taken from this exposure are said to assay lead, 6%, silver, 5 ounces. In this area the beds of limestone are three to four feet thick and at intervals show scattered bunches of galena disseminated throughout the rock mass. At an elevation of 4000 feet, and 100 feet vertically below No. 1 tunnel, the Staunton tunnel or No. 2 tunnel has been driven S. 40° W., 220 feet. At 50 feet from the portal the crosscut tunnel cuts a north and south fracture which dips 70° east. Here six feet of ore is exposed on the north side of tunnel, and reported lead 6%, silver 5 ounces. At 75 feet from portal the tunnel intersects another north and south fracture. The ore on this fissure has a width of 12 feet and is said to assay lead 7%, silver 5 ounces. The fissure was followed north for about 15 feet but no more ore was exposed and also drifted on 80 feet south but no ore developed in this drift.

At 200 feet from the portal of the tunnel, it intersected a cave which occurs on the bedding planes of the limestone. This cave, so far as explored, shows a depth of about 200 feet and is 50 to 75 feet in width and probably extends above the tunnel to a height of 75 feet. At a depth of 75 feet below tunnel level, in the roof of the cave, there is a north and south fissure about $\frac{1}{8}$ " wide filled with galena. Samples from this streak of sulphide assayed lead 50%.

The cave is lined with crystals of calcite. The extent of the cave had not been determined at the time the property was visited but will be explored to determine if it contains any lead carbonate ore. Another tunnel known as the Berger tunnel is located 650 feet southeast of No. 2 tunnel and at the same elevation. This tunnel is in 40 feet and it is proposed to drive it southwest 900 feet to cut below ore croppings that occur southeast of No. 2 tunnel.

Canyon Gate No. 1 Claim is located north of the March Storm group of claims and three-quarters of a mile from the main workings. At an elevation of 3800 feet, a tunnel is being driven on the northeast side of Chambers Canyon and about 150 feet vertically above the floor of the canyon. The tunnel is being driven on a N. 20° E. fissure in the limestone. Near the portal of this tunnel there is exposed four feet of gray limestone mineralized with galena. Samples taken are said to assay lead 3%, silver 3 ounces. The tunnel has been driven 25 feet but no ore is exposed in the face.

Sunrise Group of Claims. The group comprises six claims known as North Slope, Sunrise, Fargo No. 1 and Fargo No. 2, Eco, No. 1, No. 2 and No. 3. These claims are located about one mile southeast of the March Storm group, at an elevation of 4800 feet. The principal work has been on the Sunrise claim. Several short tunnels have been driven southwest, cutting beddings of the limestone. These workings have exposed 8 feet of limestone which is mineralized with galena and also galena is found replacing veins of calcite which are quite prominent on this claim. In one tunnel three feet of ore is exposed, the galena occurring in lenses of massive calcite and barite. The calcite is also stained with malachite and azurite.

The equipment on the March Storm group of claims consists of 9" x 8" Sullivan compressor driven by a 15-h.p. gas engine. This equipment, which is being used in driving No. 2 tunnel, is to be replaced by a 180-h.p. Fairbanks-Morse semi-Diesel gas engine which drives an Imperial type Ingersoll-Rand compressor (10½" x 14") (17" x 14"). There is a cooling tower and water supply tanks, capacity 10,000 gallons.

Western Lead No. 2. Dr. Benson, president, owns a group of seven claims one mile west of the Leadfield Carbonate Mine and two miles west of Leadfield. Elevation 4200 feet. On the north end of a limestone belt that strikes north and lies northeast of Titus Canyon, there is an exposure showing galena disseminated throughout the rock for six feet in width. This company is driving a tunnel to develop the surface showing.

MOLYBDENUM.

The two principal molybdenum minerals are: the sulphide, molybdenite; and wulfenite, lead molybdate; the former furnishing practically the entire commercial output.

Deposits of disseminated molybdenite occur in several localities in Inyo County. Wulfenite, lead molybdate, occurs with lead ores in the Slate Range, especially at the Ophir mine. Molybdenite occurs scattered through a quartz vein along a contact between granite and limestone on the east slope of the Inyo Mountains, 7 miles east of Kearsarge. This deposit is known as the Lucky Boy. It occurs at the Pine Creek tungsten deposit, on the south slope of Mount Morgan in the Sierra Nevada, at an elevation of 11,200. A high-grade stringer of molybdenite was found here on contact of granite and the tungsten orebody. The ore carried as high as 90% molybdenite.

TUNGSTEN.

Tungsten ores occur in Inyo County as scheelite (calcium tungstate) in the Tungsten Hills west of Bishop, Round Valley, Deep Springs Valley, Ubehebe District and the Pine Creek deposits in the Sierra Nevada.

There has been no activity in the mining of tungsten ores in Inyo County since 1920, when the mines were shut down owing to low prices. In 1924 the Tungsten Products Company, operating the Pine Creek Tungsten mine resumed operations and is at present the only producer in the county.

Mines.

Deep Springs Valley Deposits. These deposits are situated 22 miles northeast of Zurick, a station on the Southern Pacific Railroad, on the



Outcrop on Pine Creek Tungsten Mine, Pine Creek, Inyo County.

east slope of the White Mountains, at the north edge of Deep Springs Valley. Idle.

Bibl: State Mineralogist's Report XVII, p. 301.

Pine Creek Tungsten Mine. It is situated 45 miles by road northwest of Bishop, on the south slope of Mount Morgan, in the Sierra Nevada. Elevation 11,200 feet. Owner, Tungsten Products Company. W. W. Watterson, president; L. Henderson, secretary; Jerome Watterson, superintendent, Bishop, California. Holdings comprise five claims located in 1918.

It is a contact metamorphic deposit between dolomite footwall and granite hanging wall. The ore occurs as scheelite (calcium tungstate) in minute crystals disseminated in a garnetiferous gangue. The ore mined carries from 0.5% to 0.7% WO_3 . The deposit strikes N. 20° E. and is 120 feet long and 70 feet wide, and 130 feet in depth below the glory hole.

Development consists of main haulage tunnel driven N. 30° E., 1500 feet; at 1200 feet a raise connects with the upper tunnel and glory hole, a distance of 375 feet. Upper tunnel is 325 feet vertically above lower tunnel and is 500 feet in length. A sub-level 80 feet below upper tunnel defines the limits of the orebody in depth. It is estimated that there is developed one million tons of ore that will average 0.6% WO_3 . The ore is trammed from the lower transportation tunnel in a train of six cars, each having a capacity of one ton, to storage bins at the end of the tunnel. From these bins it is transported to the mill over an incline tramway in skip cars, having a capacity of two tons. The mill has a rated capacity of 200 tons per 24 hours, but is treating 175 tons per day. The average mill heads carry 0.6% WO_3 . The recovery made by concentration, flotation and magnetic separation is 70%, producing a product assaying 70% WO_3 .

Mine equipment consists of four 9" x 8" Ingersoll-Rand compressors each driven by a 25-h.p. motor. Power is furnished by the Southern Sierras Power Company. Forty-five men are employed.

Bibl: State Mineralogist's Report XVII, pp. 301-302.

Round Valley Tungsten Mine. It is situated 11 miles northwest of Bishop, on the north slope of the Tungsten Hills at the edge of Round Valley. Elevation 5350 feet. Owner, Round Valley Tungsten Company. Cooper Shapley, Bishop, California. Idle.

Bibl: State Mineralogist's Report XVII, pp. 302-303. U. S. G. S. Bull. 640b.

Standard Tungsten Mine. It is situated 8 miles west of Bishop in the Tungsten Hills. Elevation 5500 feet. Owner, Standard Tungsten Company, Los Angeles, California. Idle.

Bibl: State Mineralogist's Reports XV, pp. 129-130; XVII, p. 303. U. S. G. S. Bull. 640b.

Tungsten Mines Company. It is situated 8 miles west of Bishop in the Tungsten Hills. Owner, W. W. Watterson, Bishop, California. Idle.

Bibl: State Mineralogist's Reports XV, p. 133; XVII, pp. 304-305. U. S. G. S. Bull. 640b.

NON-METALLIC MINERALS.

Inyo County has a great variety of commercial minerals which are used locally and a large tonnage of both industrial and structural materials are shipped out of the county to manufacturing centers along the Pacific Coast. Deposits of barytes, clay, dolomite, limestone, marble and talc are distributed throughout the county and transportation and other facilities are gradually being extended so that the growing demand may be met.

BARYTES.

Gunter Canyon Barite Deposit. It is located in Gunter Canyon on the west flank of the White Mountains, six miles northeast of Laws, a

station on the California and Nevada Railroad. Elevation 6300 feet. Holdings comprise two claims. Owner, Joseph Smith, Laws, California.

A series of parallel veins of barite occur in Cambrian schists and slates. These veins trend N. 30° W. and dip 60° E. and are from 2 to 8 feet in width. A considerable tonnage is exposed on each side of the canyon. The barite is pure white and is reported to carry 94% barium sulphate.

CLAY.

Extensive beds of Tertiary clay occur along the Amargosa River in the vicinity of Shoshone and Tecopa. These beds vary in thickness from 6 to 20 feet and in different localities are covered with an overburden of volcanic ash and gravel wash.

Fairbanks Clay Deposit. It is situated one mile southeast of Shoshone, on the west side of the Amargosa River. Holdings comprise 160 acres. Owner, R. J. Fairbanks, Shoshone, California. Elevation 1600 feet.

The beds of clay trend north and south and are 6 to 8 feet thick overlain by 4 to 6 feet of volcanic ash. The clay is green in color and quite plastic.

The Pacific Minerals and Chemical Company and the Tropico Potteries Company, of Tropico, California, also own deposits of clay located between Shoshone and Zabriskie.

DOLOMITE.

The principal mountain ranges east of the Sierra Nevada Range are made up in places of dolomitic limestone. The only commercial deposits being developed are those of the Inyo Marble Company, of Los Angeles, California.

These deposits occur on the southwestern flank of the Inyo Range and extend for about 6 miles northeastward from Swansea station. A large tonnage of this material is used by the different soda plants on Owens Lake for manufacture of CO₂. A considerable amount of the dolomite is also shipped to Los Angeles to be utilized for steel furnace lining, flux, and for stucco dash and terrazzo.

FULLER'S EARTH.

Fuller's earth includes many kinds of unctuous clays. It is usually soft, friable, earthy, white and gray to dark green in color, and some varieties disintegrate in water. The principal production in Inyo County of clay, known as bentonite and shoshonite (being varieties of the mineral montmorillonite), a colloidal clay, is from Shoshone, a station on the Tonopah and Tidewater Railroad.

The most extensive beds of bentonite are those along the Amargosa River in the vicinity of Tecopa, Shoshone and Ash Meadows, extending across the state line into Nye County, Nevada. About 4 miles southeast of Tecopa, in a canyon draining into the Amargosa River, there is a bed of bentonite 6 feet thick. The bentonite is of good quality, but contains a large amount of gravel. The deposit at Shoshone adjoins the right of way of the Tonopah and Tidewater Railway, on the west. It

occupies an area of about 200 acres and outcrops above the level of the valley floor. The bentonite bed is from 1 to 10 feet thick and is overlain by an overburden of recent sediments 8 to 15 feet thick. This overburden makes it difficult and costly to mine the material. This deposit is owned and operated by the Associated Oil Company.

Amargosite or bentonite, when mined, weighs about 65 pounds per cu. ft., sp. gr. 2.45. It is very smooth, soft and friable, but not plastic. The color is dead white. Bentonite is chiefly used by local oil refineries for cleaning heavy lubricating oils, kerosene and gasoline.

Analysis of amargosite is as follows:

Silica SiO_2 -----	50.56%
Alumina Al_2O_3 -----	15.62%
Iron Oxide Fe_2O_3 -----	0.24%
Calcium Oxide CaO -----	1.48%
Magnesium Oxide MgO -----	4.56%
Potassium Oxide K_2O -----	0.60%
Sodium Chloride NaCl -----	7.17%
Combined Water H_2O -----	19.12%
Total -----	99.30%

Several of the oil companies are now securing their material from Ash Meadows for the reason that the cost of mining is less, as these deposits have very little overburden, also the bentonite from Ash Meadows does not require an acid wash.

Filtrol Company's Deposit. It is situated two miles northwest of Shoshone, west of the Amargosa River and north of the Shoshone deposit worked by the Associated Oil Company. Holdings comprise 280 acres. Elevation 1600 feet. Owner, The Filtrol Company, W. S. Bayliss, president, 326 Bartlett Building, Los Angeles, California.

The bed of bentonite is from 1 to 6 feet thick, and is covered with recent sediments 20 feet thick. The material was mined by stripping overburden and also by underground method through a tunnel driven northwest through a small hill. The deposit is practically worked out. Idle

Bibl: State Mineralogist's Report XVII, p. 298.

Shoshone Bentonite Deposit. The deposit is situated one-quarter of a mile west of Shoshone. Holdings consist of 320 acres. Elevation 1700 feet. Owner, Associated Oil Company, San Francisco, California. A. B. Peckham, superintendent.

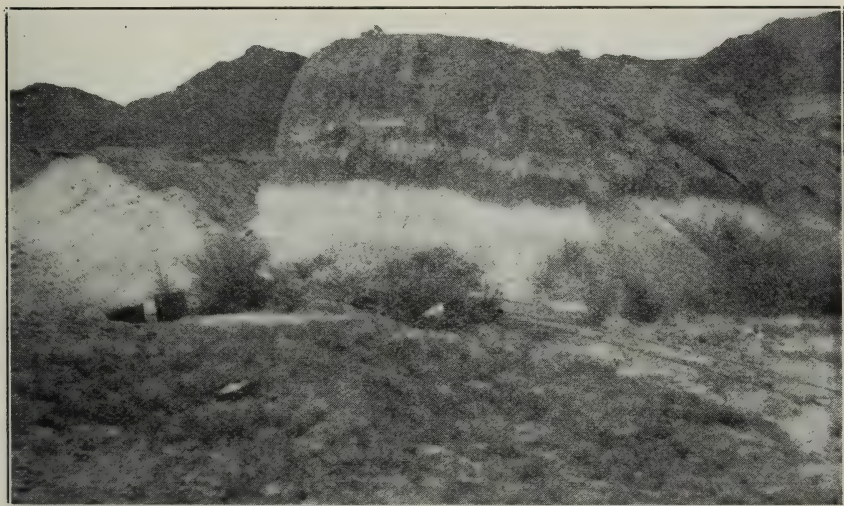
The beds of bentonite are laid down horizontally and are 7 to 10 feet thick, covered by overburden of recent sediment 3 to 15 feet thick. The bed of bentonite is exposed on both sides of a small basin, but has been mined only from the north side of this basin. Its extent has been proved 1000 feet in a north and south direction and about 800 feet in an easterly direction. The overburden is first stripped off and the clay is mined by hand, then trammed in cars to a drying floor, from which it is loaded into bins. A spur track connects the deposit with the Tonopah and Tidewater Railroad. The deposit is operated only in the summer months when the shipments average 7 cars per month.

Bibl: State Mineralogist's Report XVII, pp. 297, 298. Eng. & Min. Jour.-Press, Vol. 121, pp. 837-842, May 22, 1926.

LIMESTONE.

Deposit of limestone occur in the Inyo Range but the only deposits which are being worked on a commercial scale are located on the Cerro Gordo Mining Company's property. The limestone is mined through the Union tunnel and transported over a tramway to bunkers at Keeler, from which it is hauled in railroad cars to the plant of the Natural Soda Products Company, and also is being shipped to the Clark Chemical Company's plant, located at Bartlett, on the west shore of Owens Lake.

Rogers Limestone Deposit. The deposit is located in Silver Canyon, on the west slope of the White Mountains, 7 miles northeast of Laws. The limestone is very pure, being 98% CaCO_3 , and is white in color. The material is hauled by truck to a siding on the California and Nevada Railroad and is shipped to soda plants on Owens Lake.



Bedded deposit of bentonite at Shoshone, Inyo County.

West End Chemical Company is operating a quarry located in the foothills of the Slate Range, 12 miles northeast of Trona. The rock quarried is a dolomitic limestone. The rock is hauled by trucks to the company's potash plant which is located on the southwest shore of Searles Lake. Ten men are employed.

MARBLE.

The marble deposits of Inyo County occur on the southwestern flank of the Inyo Range and extend for 6 miles northeastward from Swansea, a station on the California and Nevada Railroad. The marble outcropping along the base of this range shows a thickness of at least 500 feet. The beds are tilted at a high angle dipping northwestward into the mountain. The marble is dolomite, fine-grained and hard. The white marble beds extend for a distance of several miles but are much

shattered by cross faulting. The marbled beds are of vast thickness and continuity, both in depth and extent. Four varieties of marble are found, a pure white marble, a beautiful yellow marble and variegated marble of white ground mass, penetrated by dendritic markings of manganese. Chemically these marbles are a very pure dolomite, close-grained and compact and equally well adapted for exterior work.

Inyo Marble Company. D. H. Dunn, president; Robert H. Tune, secretary; J. F. Menzies, superintendent. Offices, Los Angeles. The company's holdings comprise 24 placer locations, 7 miles north of Keeler, on the west flank of the Inyo Range. Elevation 3700 feet. Six quarries have been opened up on the different colored marbles.

The most extensive workings are at the following quarries:

Golden Yellow quarry, which is located in the center of the property, one mile southeast of camp. The marble has been exposed for a distance of 150 feet in length and 200 feet in height above the floor of the



Golden Yellow Marble Quarry, Inyo Marble Co.,
Swansea, Inyo County.

quarry. The color of the marble is golden yellow, brown and white. About one-quarter of a mile south of this quarry, another has been opened up for 500 feet in length. Present operations are confined to the Alco quarry which is located east of Dolomite siding, on the California and Nevada Railroad, and one mile north of the camp, with a spur track from the main line to the quarry. The rock being quarried is utilized by the chemical plants on Owens Lake. The marble is snow-white in color and is broken in sizes from 4 inches to 10 inches. The quarry is 1000 feet long and several hundred feet in height above the floor.

Equipment consists of Rix air compressor driven by a 15-h.p. gas engine, crushing plant, derricks and saws. Thirty-five men are employed.

Bibl: State Mineralogist's Reports X, p. 215; XII, p. 392; XIII, p. 628; XV, p. 111; XVII, p. 295. Bull. 38, pp. 99, 100.

MINERAL SPRINGS.

The mineral springs of Inyo County are described in detail by Gerald A. Waring in "Springs of California," Water Supply Paper 338, issued by the U. S. Geological Survey, 1915, so only those springs that are operated on a commercial scale will be mentioned in this report.

Coso Hot Springs. These hot springs are situated on the eastern slope of the Coso Range, 11 miles east of Coso Junction, a station on the Southern Pacific Railroad. Elevation 3000 feet. Owner, Coso Hot Springs, Inc. W. W. Watterson, president; M. Q. Watterson, secretary; F. J. Saunders, vice president and general manager. Offices, Metropolitan Theatre Building, Los Angeles. Holdings of the company comprise 480 acres, in which area are located 250 mineral springs.

The rocks of the region in the vicinity of the springs are largely granite which is covered in some places by lava flows and lava craters

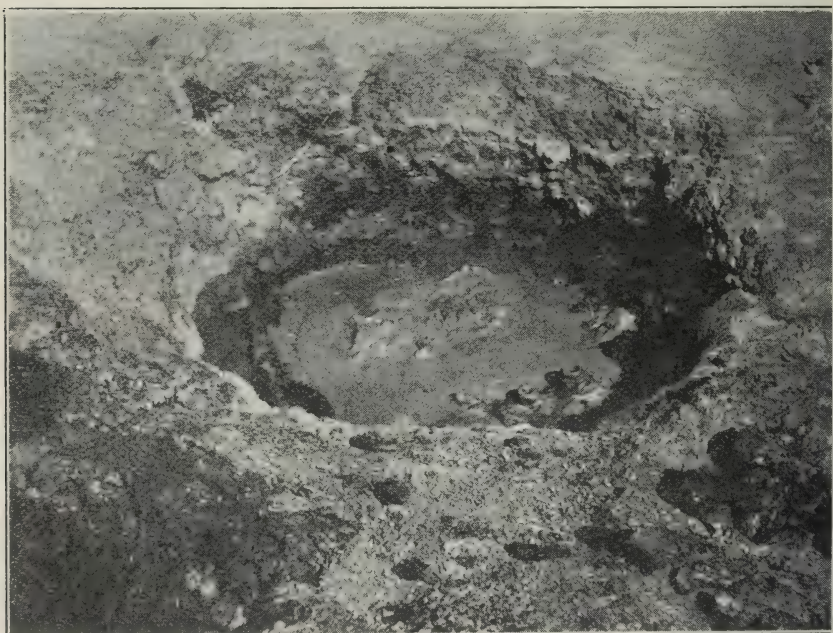


Coso Hot Springs, Coso Range, Inyo County.

of a recent geological period of eruption. The crater spring, located south of the hotel, is the principal spring, and is a pit in the form of a crater about 50 feet by 100 feet in diameter and 10 feet deep. Vapor and hot water rise through a white mud which is apparently formed by the decomposition from the granitic rock. North of this crater is an area of steam vents and numerous hot springs that are quite active and cover an area several hundred feet in length by 200 feet in width. The main supply of water for bottling purposes is secured from these springs. Several hundred yards north of these springs five wells have been drilled to a depth of 30 feet and the steam issuing from these wells is piped to bathhouses containing rooms for steam and mud baths. The white mud that occurs near and around the different springs is used for the mud baths. The water contains large amounts of sulphate of iron, alumina and silica. The most remarkable feature is its high tertiary salinity. In connection with the large iron and sulphate content, it is of interest to note that minute crystals, apparently of pyrite,



Steam Vents at Coso Hot Springs, Coso Range, Inyo County.



Mud Springs at Coso Hot Springs, Inyo County.

collect as a film on the water, and also form on the clay at the side of the pools. The water is said to be especially good for people afflicted with rheumatism and has been used by the Indians for years. Two miles west of Coso Springs, in a canyon south of the road, there is another group of springs and steam vents. The hotel and cottages will accommodate about 50 people. The water from the springs is put in bottles in the bottling works at the springs, then hauled by trucks to the warehouse at Coso Junction.

The following are analyses of water and mud from Coso Hot Springs:

Coso Mineral Water Analysis.

	<i>Parts per million</i>
Silica (SiO_2)	458.0
Alumina (Al_2O_3)	570.4
Iron oxide (Fe_2O_3)	13.6
Phosphoric anhydride (P_2O_5)	0.7
Boric anhydride (B_2O_3)	0.0
Calcium sulphate (CaSO_4)	227.6
Magnesium sulphate (MgSO_4)	5,153.0
Potassium sulphate (K_2SO_4)	95.8
Sodium sulphate (Na_2SO_4)	1,840.0
Sodium chloride (NaCl)	3.8
Total solids	8,362.9
Sulphuric acid (H_2SO_4)	452.2
Arsenic in terms of arsenious acid (As_2O_3)	0.04
Permanganate consumed in terms of potassium permanganate (KMnO_4)	5.5

ARTHUR R. MAAS LABORATORIES.

Los Angeles.

Coso Volcanic Bath Mud Analysis.

Silica (SiO_2)	50.50%
Iron oxide (Fe_2O_3)	1.44%
Aluminum oxide (Al_2O_3)	20.16%
Titanium oxide (TiO_2)	0.80%
Calcium oxide (CaO)	0.68%
Magnesium oxide (MgO)	0.20%
Potassium oxide (K_2O)	1.45%
Sodium oxide (Na_2O)	0.45%
Moisture ($\text{H}_2\text{O}-105^\circ\text{C}$)	3.63%
Combined water ($\text{H}_2\text{O}+105^\circ\text{C}$)	18.63%
Arsenic oxide (As_2O_3)	0.001%
Boric anhydride (B_2O_3)	None
Phosphoric anhydride (P_2O_5)	Trace
Sulphuric anhydride (SO_3)	1.39%
Chlorine (Cl)	0.13%
Carbon dioxide (CO_2)	0.42%
	99.88%

Determinations.

Water soluble salts	2.195%
Sodium carbonate (Na_2CO_3)	0.001%
Sodium chloride (NaCl)	0.214%
Aluminum sulphate ($\text{Al}_2(\text{SO}_4)_3$)	1.980%

SMITH-EMERY COMPANY, Chemists,

Los Angeles.

Keough Hot Springs. These springs are situated 8 miles south of Bishop on the west side of Owens Valley, at the base of the Sierra Nevada Range. Owner, City of Los Angeles. 140 acres is under lease to George L. Vonderheide.

A spring of considerable flow issues from granitic rocks, the temperature of the water being about 130°F . The estimated flow is 1,188,000 gallons daily. The water is classified by the U. S. Bureau of Chemistry as a "Muriated alkaline-saline water." The water is said to be especially valuable in the treatment of catarrhal condition. Two other

smaller springs are located on the property and probably rise from the same source in the granites. The water from the springs flows in cement launders to the bathhouse and swimming pool. The bathhouse contains seven tubs. The swimming pool is 100 feet in length by 40 feet wide and from 3 to 9 feet deep. The water for the pool goes through a cooling tower, where it is cooled to a temperature of 78 degrees. Fresh water supply is secured from Cold Creek. There are accommodations, consisting of hotel and 17 cottages, for 75 guests.

Analysis of the water is as follows:

	<i>By weight grs. per gal.</i>
Silica -----	2.26
Iron and aluminum oxides -----	Trace
Calcium carbonate -----	1.59
Sodium carbonate -----	0.80
Sodium sulphate -----	5.33
Sodium chloride -----	17.07
Total solids -----	27.05

ARTHUR R. MAAS, Chemist,
Los Angeles

This water is also reported to have radio-activity.



Keough Hot Springs, near Bishop, Inyo County.

PHOSPHATES.

A deposit of phosphate rock occurs 6 miles east of Big Pine, on the Big Pine-Saline Valley Road. The phosphate occurs in the Pleistocene sediments that occur near the base of the White Mountains. Open-cuts have been made along a thin bed that occurs in the strata of clay. Owner, Big Pine Fertilizer Company, San Fernando Road, Los Angeles, California.

PUMICE AND VOLCANIC ASH.

Deposits of pumice occur in the Coso Range, 6 miles east of Coso Junction, a station on the Southern Pacific Railroad, and also north-east of Laws, on the west slope of the White Mountains, near the Mono

County line. Extensive beds of volcanic ash occur in the Tertiary sediments of the Amargosa Valley near Shoshone.

Coso Mountain Pumice Deposit. The deposit is situated on the west slope of the Coso Range, 6 miles east of Coso Junction. Elevation 3800 feet. Holdings comprise 320 acres. Owners, H. P. Thelan, of Coso Junction, and Walter W. Brown, of Los Angeles.

Opencuts have exposed a bed of pumice 6 to 10 feet thick, which is covered in places by a rhyolite flow. The pumice is gray in color, but quite soft, as after exposure it disintegrates to fine gray powder. It can be quarried in large blocks. Several carloads were shipped from the deposit in 1920. There has been no recent production.

Hunter Canyon Pumice Deposit. It is located in Hunter Canyon, $3\frac{1}{2}$ miles northeast of Laws, on the west slope of the White Mountains. Holdings comprise 20 acres. Elevation 5500 feet. The pumice is exposed over the entire 20 acres, with only a small amount of overburden. The pumice is white in color, and very fine, the maximum size being 2 inches.

Fairbanks Volcanic Ash Deposits. These deposits comprise two groups of claims, one located west of the Amargosa River, and the other to the east of the river in Secs. 32, 33, T. 22 N., R. 7 E., M. D. B. and M. Elevation 1600 feet. The west deposit is located one-quarter of a mile west of Shoshone and south of the Associated Oil Company's bentonite deposit. Holdings comprise 500 acres.

A bed of tuff is deposited in the Pleistocene sediments of the Amargosa Valley. The bed is 6 to 8 feet thick, and is covered with an overburden of sand, gravel and clay.

The east deposit of volcanic ash is located one mile southeast of Shoshone, south of the Shoshone-Pahrump Valley Road. Holdings comprise 160 acres. Owner, R. J. Fairbanks, Shoshone, California.

The bed of volcanic ash, which overlays a bed of green clay 6 feet thick, is 4 to 6 feet thick. There is very little overburden on this deposit. The bed is impure, carrying some lime with the tuff. The material can be utilized for making soap and cleanser compounds.

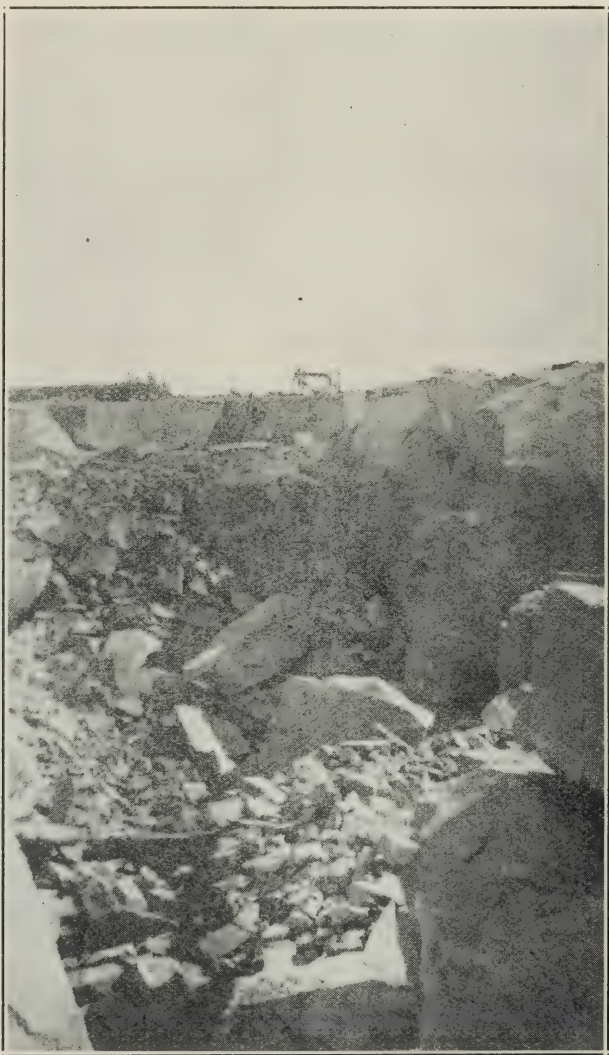
Chemical Analysis of Shoshone Tuff.

Silica	68.43%
Iron and aluminum oxides	12.94%
Calcium oxide	1.17%
Magnesium oxide	0.22%
Potassium oxide	2.15%
Sodium oxide	3.50%
Carbon dioxide	0.21%
Sodium chloride	0.47%
Combined water	10.01%
Total	99.10%

Glendening Volcanic Ash Deposit. It is located two miles south of Shoshone in Sec. 31, T. 22 N., R. 7 E., M. D. B. and M., on the west side of the Amargosa River. Elevation 1800 feet. Holdings comprise 8 claims, known as the *Virginia Group*. Owner, R. W. Glendening, Los Angeles.

A bed of volcanic ash is exposed in a canyon that trends southeast into the Amargosa Valley. The bed is 2 to 4 feet thick and is covered with gravel wash two feet thick. The tuff is mined from both sides

of the canyon and hauled in truck to Shoshone for shipment to Los Angeles. The material breaks in large blocks and can be mined at a low cost. It is utilized for making soap and cleanser compounds.



Round Valley Tuff Quarry, Round Valley, Inyo County.

STONE.

Round Valley Tuff Quarry. It is situated in Round Valley, 10 miles northwest of Bishop. Elevation 4550 feet. Owner, Bly Stone Company, 1935 E. 16th Street, Los Angeles.

Volcanic Cinder Deposit. It is located three miles north of Little Lake and east of Coso Junction, a station on the Southern Pacific Railroad. Holdings comprise 160 acres, covering Red Mountain,

located in Sec. 30, T. 22 S., R. 37 E., M. D. B. and M. Elevation 3450 feet. Owners, H. P. Thelan and G. B. Rogers, of Coso Junction, California.

The deposit consists of a volcanic cinder cone that forms a rounded butte north of Little Lake. The material is utilized for red roofing and road building purposes. Several pits and opencuts are on the west slope of the hill, with crusher and bins.

SULPHUR.

Associated Sulphur Mines. These mines are situated in the Coso Range, two miles southwest of Coso Springs and 9 miles east of Coso Junction, a station on the Southern Pacific Railroad. Elevation 3500 to 3850 feet. Owner, Coso Hot Springs, Inc. W. W. Watterson, president; M. Q. Watterson, secretary, Metropolitan Theatre Building, Los Angeles.

Small deposits of sulphur occur in an area several acres in extent in which much vapor issues and the ground around the vapor vents is impregnated with sulphur and alum. These vents are in an area of lava where there are a number of small volcanic craters and the surface is covered with fragments of pumice and obsidian. The sulphur is deposited by solfataric action.

Last Chance Range Sulphur Deposits. Deposits of sulphur occur in the Last Chance range of mountains 10 miles southeast of the Loretta Copper Mine. The sulphur occurs in fractures in the limestone. The outcrops are said to be from 5 to 30 feet in width and traceable for several hundred feet. Samples taken from the outcrops are reported to carry 90 to 96% sulphur. A number of claims are located along the surface showings by David Cuddeback and associates, of Big Pine. Under option to J. M. Cooper, of Los Angeles.

Bibl: State Mineralogist's Report XVII, p. 300; Bull. 86, p. 138.

TALC.

California Mineral Corporation Talc Deposit. The deposit is 8 miles southwest of Zabriskie, a station on the Tonopah and Tidewater Railroad. The talc occurs along a contact of limestone and diorite. The talc is pure white in color and varies in width from 2 feet to 12 feet. Owner, Western Talc and Magnesite Company, Los Angeles.

Bibl: State Mineralogist's Reports XV, p. 120; XVII, p. 300.

Inyo Talc Company's Deposit (Simonds Talc Mine). It is situated in the Darwin District, 17 miles by road southeast of Keeler. Elevation 5850 feet. Owner, Sierra Talc Company. P. H. Booth, president; Franklin Booth, secretary; W. A. Reed, superintendent. Offices, Equitable Bank Building, Los Angeles.

This mine is the largest producer of talc in the county and has been a producer since 1918. The deposit occurs in a crushed zone in impure limestone, close to or in contact with an igneous intrusion. The strike of the orebody is N. 30° E. and dip 60° to vertical. The outcrop can be traced for 3000 feet.

Recent development has opened up a parallel lenticular orebody 150 feet southeast of the glory-hole orebody. This orebody on the tunnel level is 300 feet in length and 30 feet wide. The deposit is developed by a number of tunnels and opencuts. The main tunnel is driven southeast 800 feet as a crosscut in the limestone. At 260 feet from the portal it cut the glory-hole orebody, which was 70 feet in width. A shaft has been sunk on an incline of 45° to a depth of 185 feet. A crosscut from the bottom of the shaft is being driven southeast 280 feet for a second orebody. The talc mined varies in color from gray to green and pure white, and is hard and slippery. The talc is hauled by trucks to a grinding plant at Keeler, having a capacity of 30 tons per day. Twenty men are employed.

Bibl: State Mineralogist's Reports XV, pp. 126-127; XVII, pp. 300-301. U. S. Bur. of M., Rep. of Investigations, Serial No. 2253, May, 1921.

Saline Valley Talc Deposit. A large deposit of talc is reported on the east flank of the Inyo Mountains in Saline Valley. Locations have been made on the property by White Smith, of Bishop, California. The talc is said to be pure white in color and to be suitable for switch-board material.

Tramway Talc Mine. It is situated in the Keeler District, $3\frac{1}{2}$ miles northwest of Keeler, at the base of the Inyo Mountains near the tramway terminal of the Saline Valley Salt Company. Elevation 3800 feet. A vein of greenish-gray to black talc occurs in limestone. Idle.

Bibl: State Mineralogist's Reports XV, pp. 127-128; XVII, p. 301.

Troeger Talc Deposit. It is located on the east flank of the Inyo Mountains, about 6 miles north of Cerro Gordo. Elevation 8000 feet.

The talc is said to be of good quality, white to gray in color. The deposit is reached by trail from the Cerro Gordo mine. Idle. Owner, Roy Troeger, of Los Angeles, California.

SALINES.

BORAX.

The colemanite (calcium borate) deposits of Inyo County occur in the foothills of the Black Mountains east of Furnace Creek. They extend in a narrow belt for many miles and are owned by the Pacific Coast Borax Company. The most recent discovery and what has developed into a very large deposit of colemanite, was made on school land located two miles north of Shoshone by Jack Sheridan, of Shoshone, California, in 1921. This deposit is being worked under a lease from the state of California by the Pacific Coast Borax Company.

The borax deposits of Inyo County are the largest and have been the most productive of any county in California. The county has been a steady producer of borax since its discovery in Saline Valley in 1874. The borax occurs both as colemanite and ulexite, the former being the hydrous borate of calcium ($\text{Ca}_2\text{B}_6\text{O}_{11}5\text{H}_2\text{O}$), while the latter is the hydrous borate of calcium and sodium ($\text{NaCaB}_5\text{O}_98\text{H}_2\text{O}$).

Pacific Coast Borax Company. The main borax deposits of this company are situated near Ryan, 20 miles northwest of Death Valley Junction, a station on the Tonopah and Tidewater Railroad. At Death Valley Junction the company operates a 300-ton crushing and concentrating plant for the treatment of second-class ore. The ore is transported from the mines at Ryan over a narrow-gauge railroad to the plant at Death Valley Junction. The ore mined from the different mines of the company is segregated into first and second-class ore. The first-grade ore is shipped direct to the refineries at Bayonne, New Jersey, Alameda or Wilmington, California, while second-class ore goes to the concentration plant at Death Valley Junction.

The borate-bearing beds in the vicinity of Ryan are a part of a series of Tertiary lake beds which consist of thin-bedded, light-colored shales. Underlying these shales are thick beds of sandstone and tuff. The sandstone exposures form conspicuous bluffs at the camp of Ryan



State Lease Mine, operated by Pacific Coast Borax Company, Shoshone, California.

below the Upper Biddy workings. The borate-bearing beds are capped with basalt, which forms the crest of the ridge back of the mines. The colemanite deposits are distinctly bedded and vary in thickness up to 100 feet. The strata have been considerably faulted so there is no great regularity to the deposits. The different mines operated by the company in this region have been described in detail in the State Mineralogist's Report XVII, pp. 275-277, and a description of the concentration plant is contained on page 277 of the same report. Two hundred men are employed at mines and concentration plant. Owner, Pacific Coast Borax Company. Offices, Syndicate Building, Oakland, California. R. C. Baker, president; W. F. Wemphal, secretary; John Ryan, general manager; Major J. Boyd, mine manager; F. W. Corkill, plant manager.

Bibl: State Mineralogist's Reports XV, pp. 62-69; XVII, pp. 274-277.

State Lease Mine. It is located in Sec. 16, T. 22 N., R. 7 E., two miles northeast of Shoshone. Elevation 2000 feet. The property is operated by the Pacific Coast Borax Company, under lease from the State of California.

The borax occurs both as colemanite and ulexite, in a series of parallel flat-dipping beds that trend N. 30° W. and dip 30° to 40° SW. These beds are from 200 to 700 feet in length and 30 to 40 feet thick. The borate-bearing beds are a part of a series of Tertiary lake beds which consist of thin-bedded, light-colored shales. The beds are capped with basalt that forms the crest of the ridge above the mine. The strata have been considerably faulted so there is no great regularity to the ore deposits.

Developments consist of a tunnel driven east 1800 feet, then drifted south 600 feet, and then south 40° E., 400 feet; and a shaft 180 feet deep. The tunnel is 120' vertically below the outcrop. The ore is trammed in 1½-ton cars to 250-ton storage bins. Then it is hauled in a train of seven 5-ton cars over a narrow gauge road by gasoline-driven motor to loading bins at Gerstley siding, on the Tonopah and Tidewater Railroad, a distance of 4 miles. The ore is shipped to Death Valley Junction for treatment at the company's concentration plant. Shipments amount to 2500 tons per day. Thirty-five men are employed. J. J. Rogers, superintendent.

GYPSUM.

Deposits of gypsum occur in the Resting Springs District, on the Morrison Ranch, one mile northeast of Acme Station, on the Tonopah and Tidewater Railroad. The Pacific Coast Borax Company owns a large deposit of gypsum located in the foothills of the Black Mountains, one mile from the Death Valley Railroad.

Bibl: State Mineralogist's Reports XV, pp. 85, 87; XVII, p. 282.

NITRATES.

The niter beds are situated in the southeastern part of Inyo County extending across the boundary line into the northern part of San Bernardino County.

The principal deposits are known as the Confidence beds, situated along the south side of Death Valley, northwest of Saratoga Springs.

Bibl: State Mineralogist's Report XV, pp. 117, 119; Bull. 24, pp. 165-174.

POTASH.

Potash occurs in Inyo County in small amounts in the saline deposits of Death Valley, Deep Springs Valley, Owens Lake and Saline Valley. There has been no commercial production to date from any of the above mentioned deposits.

Bibl: State Mineralogist's Report XVII, p. 296; U. S. G. S. Bulls. No. 540 and No. 580.

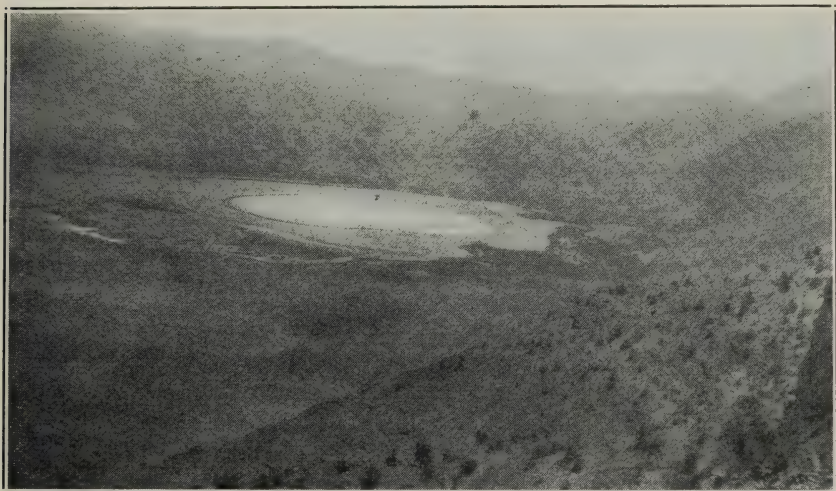
SALT.

Sodium chloride is deposited, as a major ingredient in the saline crusts of Death Valley, Saline Valley and Salt Wells Valley and in

the brines of Owens Lake. The only commercial production in the county is now from the Saline Valley deposits.

Saline Valley Salt Deposit. It is situated in Saline Valley, 12 miles northeast of Swansea and 50 miles by road from Keeler, a station on the California and Nevada Railroad. Elevation 1100 feet. Owner, Sierra Salt Company. Frank A. Stevens, president; A. S. Henderson, secretary; Geo. W. Russel, general manager; White Smith, plant manager. Offices, 553 Chamber of Commerce Building, Los Angeles.

The deposit of salt is in the lowest depression of Saline Valley. Holdings of the company comprise 640 acres of salt land and 40 acres of agricultural land. The salt bed presents a smooth, flat surface and shows a glistening snow-white field. The area of commercial salt is about two miles square, though a large area may be developed. Bore holes have been sunk to a depth of over 30 feet in salt and mud layers and ended in rock salt. The salt is recovered by dissolving the sur-



Soda-potash deposit at Deep Springs Lake, Deep Springs Valley, Inyo County.

rounding impure salt crust with water from a spring on the property and recrystallizing it by solar evaporation. The recrystallized salt is said to be 99.32% NaCl. The salt is harvested during the summer months. An aerial tramway, 13 miles in length, connects the deposit with the California and Nevada Railroad near Swansea. At present the company is planning to haul the salt by trucks to Keeler, over the new Saline Valley road. Ten men are employed.

Bibl: State Mineralogist's Reports XV, pp. 121-123; XVII, p. 297. U. S. G. S. Bull. 540, pp. 416-420.

SODA.

The only soda produced in Inyo County is derived from the water of Owens Lake. This lake covers an area of 97.2 square miles and is practically dry, as all the water of Owens River is diverted into the aqueduct of the City of Los Angeles. The brines of Owens Lake

contain common salt, soda, borax and other soluble salts. During 1926 there has been a considerable increase in the production of soda from this area. Two new plants have been built on the shores of the lake and the Inyo Chemical Company purchased the plant of the California Alkali Company in 1924. After remodeling this plant, the production has been brought up to 100 tons per day of dense soda ash. The company is also planning an additional unit for the recovery of borax. Three plants are now in operation and a fourth plant is under construction which will be on production in the early part of 1927. This latter plant will use the Kuhnert process for the recovery of borax.



Solar Vats on Owens Lake at Cartago, Inyo County.

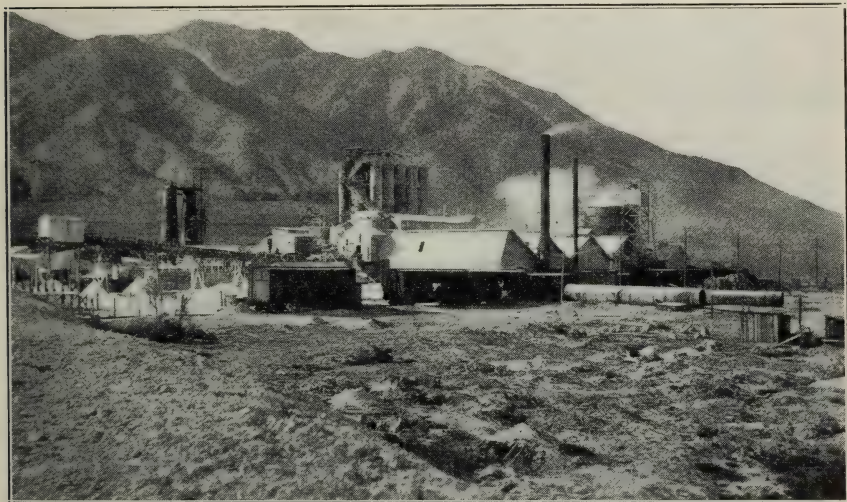
A typical analysis of the composition of the salts dissolved in the lake waters, as determined under the direction of the U. S. Geological Survey, is as follows:

Specific gravity	-----	1.195
Cl	-----	24.82
SO ₄	-----	9.93
CO ₃	-----	24.55
PO ₄	-----	0.11
B ₂ O ₇	-----	0.14
NO ₃	-----	0.45
Na	-----	38.09
K	-----	1.62
Li	-----	.03
Ca	-----	.02
Mg	-----	.01
SiO ₂	-----	.14
Al ₂ O ₃	-----	.04
Fe ₂ O ₃	-----	.05
As ₂ O ₃	-----	

Total anhydrous salts, percentage of original sample 21.37.

Bibl: State Mineralogist's Reports XV, pp. 123-124; XVII, p. 298.
Bull. 24, pp. 94-98. U. S. G. S. Bull. 580, pp. 252-264, "The Owens Basin."

Clark Chemical Company, Inc. N. B. Clark, president; Frank Bartlett, secretary; Herman Fleck, general manager. Main offices, 110 State Street, Boston, Massachusetts. Local offices, 306 Union Oil Building, Los Angeles. This company acquired the plant of the Chemical Production Company in 1925 and in 1926 the old plant was torn down and a new plant built for the recovery of caustic soda from the brines of Owens Lake. The plant is located on the west shore of the lake at Bartlett, a station on the Southern Pacific Railroad, 9 miles south of Lone Pine. The company is using the Mount Process for the recovery



Inyo Chemical Company's Soda Plant, Cartago, Inyo County.

of caustic soda from the brines. The plant has a capacity of 40 tons of 76% caustic soda per 24 hours. Forty men are employed.

Inyo Chemical Company, Detroit, Michigan. Henry M. Leland, president; Gordon G. Jackson, secretary and general manager; E. Brazil, superintendent. Offices, 1005 Pershing Square Building, Los Angeles. The plant is situated at Cartago, a station on the Owenyo branch of the Southern Pacific Railroad, on the southwestern shore of Owens Lake. This plant has a capacity of 100 tons per day of dense soda ash and sodium bicarbonate. The company also owns the Deep Springs Lake deposit, located in Deep Springs Valley, east of Big Pine. One hundred men are employed.

Bibl: State Mineralogist's Reports XVII, p. 298; XX, pp. 189-190.

Kuhnert Syndicate, George White, Agent, 1209 Pacific Mutual Building, Los Angeles. George D. Dub, superintendent.

The plant is located one mile south of the Clark Chemical Company's plant, on the western shore of Owens Lake, 10 miles south of Lone Pine. The plant consists of a testing unit being built under the supervision of Smith-Emery Company, of Los Angeles, for the purpose of

using the Kuhnert process for the recovery of borax. Ten men are employed on construction work.

Natural Soda Products Company. W. W. Watterson, president; J. S. Henderson, secretary; Walter Miller, superintendent, Keeler, California.

The plant is situated on the east shore of Owens Lake, two miles south of Keeler. The capacity of the plant is 200 tons of dense soda ash and sodium bicarbonate per day. The company also ships a large tonnage of crude trona (a double salt of sodium carbonate and sodium bicarbonate). Limestone is secured from the Cerro Gordo mine for the generation of carbon dioxide, but when not using limestone for this purpose the company secures dolomite from the Inyo Marble Company. This plant is the largest producer of dense soda ash on Owens Lake and it has been under continuous operation since 1915. The



Natural Soda Products Company's Soda Plant, Keeler, Inyo County.

company also owns the plant formerly operated by the Inyo Development Company, located one mile north of Keeler.

Fresh water is secured from 12 wells owned by the company and the fresh water canal from the Inyo Development Company's plant ties in with the main system of vats. The crude trona is harvested on the lake, seven miles west of the plant. The material from harvesting fields is hauled in a train of 9 cars, capacity 2 cu. yd. per car, by Plymouth locomotive and dumped into a bucket elevator at the plant and elevated to Oliver filters, where a small amount of water is added to the crude product, thus collecting sodium bicarbonate (Na_2HCO_3) and monocarbonate (Na_2CO_3) crystals. The crystals are conveyed to two revolving-kiln type of dryers and after drying the product is sacked for shipment. The product is known as artificially ground trona. The process for the recovery of dense soda ash is described in State Mineralogist's Report XVII, pp. 298-299. Two hundred men are employed.

Bibl: State Mineralogist's Reports XV, pp. 125-126; XVII, p. 299; XX, pp. 190-191.

OIL FIELD DEVELOPMENT OPERATIONS.

By R. D. BUSH, State Oil and Gas Supervisor.

From August 1, 1926, to and including October 30, 1926, the following new wells were reported as ready to drill:

Company	Sec.	Twp.	Range	Well No.	Field
ALAMEDA COUNTY:					
Talbott Oil Co.-----	15	3	3	1	-----
FRESNO COUNTY:					
California Northern Petroleum Co.	2	21	14	18	Coalinga
R. H. Sayers-----	14	20	14	Strong 8	Coalinga
Standard Oil Co.-----	1	20	15	11	Coalinga
Standard Oil Co.-----	11	20	15	29	Coalinga
Standard Oil Co.-----	35	19	15	201	Coalinga
Associated Oil Co.-----	36	13	16	1	-----
HUMBOLDT COUNTY:					
North Counties Oil Co.-----	36	2	1	2	-----
KERN COUNTY:					
Carneros Oil Co.-----	31	28	21	8	Belridge
Carneros Oil Co.-----	31	28	21	11	Belridge
Carneros Oil Co.-----	31	28	21	12	Belridge
Carneros Oil Co.-----	31	28	21	16	Belridge
Union Oil Co.-----	25	28	20	Theta 2	Belridge
Union Oil Co.-----	26	31	24	Elk Hills 17	Elk Hills
Chanslor-Canfield Midway Oil Co.	23	28	27	1	Kern River
General Petroleum Corp.-----	3	28	27	1	Kern River
General Petroleum Corp.-----	14	28	27	1	Kern River
General Petroleum Corp.-----	14	28	27	24	Kern River
George F. Getty-----	14	28	27	Lehnhardt 3	Kern River
George F. Getty-----	14	28	27	Lehnhardt 4	Kern River
George F. Getty-----	14	28	27	Lehnhardt 7	Kern River
George F. Getty, Inc.-----	22	28	27	Tegeler 2	Kern River
George F. Getty, Inc.-----	22	28	27	Tegeler 3	Kern River
George F. Getty, Inc.-----	22	28	27	Tegeler 5	Kern River
George F. Getty, Inc.-----	22	28	27	Tegeler 8	Kern River
Tarr & McComb, Inc.-----	2	29	28	9	Kern River
Union Oil Co.-----	8	28	27	Gill 1	Kern River
F. G. Wagner-----	34	28	28	12	Kern River
Balboa Oil Co.-----	24	31	23	51	Midway
Caribou Oil Mining Co.-----	32	31	23	13	Midway
Chanslor-Canfield Midway Oil Co.	28	31	22	1	Midway
C. R. Craft-----	21	31	22	3	Midway
Hugh B. Evans, Inc.-----	4	32	23	7	Midway
King G. Gillette-----	21	31	22	B-5	Midway
King G. Gillette-----	21	31	22	C-4	Midway
King G. Gillette-----	21	31	22	C-11	Midway
Gore Oil Co.-----	21	31	22	A-6	Midway
Gore Oil Co.-----	21	31	22	B-14	Midway
Gore Oil Co.-----	21	31	22	C-10	Midway
Gore Oil Co.-----	21	31	22	C-12	Midway
Gore Oil Co.-----	21	31	22	C-13	Midway
Gore Oil Co.-----	21	31	22	C-14	Midway
Gore Oil Co.-----	21	31	22	C-15	Midway
Hagar, Deniston and Jones-----	16	31	22	1	Midway
Honolulu Consolidated Oil Co.-----	8	32	24	8	Midway
Honolulu Consolidated Oil Co.-----	8	32	24	18	Midway
Honolulu Consolidated Oil Co.-----	8	32	24	37	Midway
Honolulu Consolidated Oil Co.-----	8	32	24	49	Midway
Honolulu Consolidated Oil Co.-----	8	32	24	59	Midway
Honolulu Consolidated Oil Co.-----	4	32	24	85	Midway
Honolulu Consolidated Oil Co.-----	6	32	24	87	Midway
Interstate Oil Corp.-----	15	32	23	Perris 6	Midway
A. T. Jergins Trust-----	15	31	22	13	Midway
Murvale Oil Co.-----	20	32	24	11-M	Midway
Pyramid Oil Co.-----	28	32	24	23	Midway

OIL FIELD DEVELOPMENT OPERATIONS—Continued.

Company	Sec.	Twp.	Range	Well No.	Field
KERN COUNTY—Continued.					
Standard Oil Co.-----	29	31	23	2	Midway
Standard Oil Co.-----	3	32	24	5	Midway
Standard Oil Co.-----	3	32	24	6	Midway
Standard Oil Co.-----	5	32	24	8	Midway
Standard Oil Co.-----	29	31	24	11	Midway
Standard Oil Co.-----	7	32	24	22	Midway
Standard Oil Co.-----	17	32	24	35	Midway
Standard Oil Co.-----	17	32	24	36	Midway
Standard Oil Co.-----	3	32	24	44	Midway
Standard Oil Co.-----	19	31	24	106	Midway
Standard Oil Co.-----	33	31	24	113	Midway
Standard Oil Co.-----	7	32	24	231	Midway
The United Oil Co.-----	19	31	23	Calidon 8	Midway
Western Production Co.-----	21	31	22	7	Midway
Western Production Co.-----	21	31	22	8	Midway
Western Production Co.-----	21	31	22	9	Midway
Western Production Co.-----	21	31	22	10	Midway
California Petroleum Corp.-----	15	27	28	Glide 1	Mt. Poso
George F. Getty, Inc.-----	19	27	27	DePauli-	
Midland Oilfields Co., Ltd.-----	34	26	27	Kane 19-3	Mt. Poso
C. J. Berry-----	34	12	24	McNeil 1	Mt. Poso
Empire Gas & Fuel Co.-----	4	11	23	Hillside 27	Sunset
Kneen-McPherson-----	4	11	23	2	Sunset
Pacific Oil Co.-----	30	12	23	5	Sunset
Union Oil Co.-----	4	11	23	19	Sunset
The United Oil Co.-----	32	12	23	Jergins 4	Sunset
The United Oil Co.-----	32	12	23	Crail 1	Sunset
L. E. Westrich-----	19	29	21	Triangle 1	Sunset
Standard Oil Co.-----	27	11	20	3	Tembler
Standard Oil Co.-----	27	11	20	Kern Co.	
				Lease No. 2 26	Wheeler Ridge
				Kern Co.	
				Lease No. 2 27	Wheeler Ridge
Barnsdall Oil Co.-----	8	27	28	1	
Barnsdall Oil Co.-----	20	27	28	1	
Barnsdall Oil Co.-----	1	28	28	1	
Bruce-Mackey-----	23	11	11	1	
Milham Exploration Co.-----	8	28	23	Kern 1	
Shell Co.-----	9	27	28	Vedder 2	
Superior Oil Co.-----	10	27	28	A. Vedder 1	
Union Oil Co.-----	5	27	28	Mack 1	
Woodward & Sheedy-----	29	27	26	1	
LOS ANGELES COUNTY:					
Union Oil Co.-----	33	3	13	Callender 15	Dominguez
Standard Oil Co.-----	16	2	14	Baldwin 71	Inglewood
Standard Oil Co.-----	17	2	14	Baldwin-	
				Cienega 41	Inglewood
Standard Oil Co.-----	17	2	14	L.A. Invest. 1 50	Inglewood
Standard Oil Co.-----	16	2	14	Stocker 7	Inglewood
Standard Oil Co.-----	16	2	14	Stocker 8	Inglewood
Sunrise Oil Co.-----	18	2	14	Phil Young, Jr. 1	Inglewood
Acme Petroleum Corp.-----	19	4	12	Damron 5	Long Beach
Ahlburg Gasoline Co.-----	13	4	13	Jennings 1	Long Beach
B. & H. Oil Co.-----	19	4	12	2	Long Beach
Dabney Oil Syn.-----	19	4	12	25	Long Beach
Dabney Oil Syn.-----	20	4	12	26	Long Beach
A. J. Delaney-----	13	4	13	35	Long Beach
A. J. Delaney-----	13	4	13	36	Long Beach
W. Helis-----	19	4	12	Twins 1	Long Beach
A. S. Johnston Drilling Corp.-----	29	4	12	1	Long Beach
Julian Petroleum Corp.-----	28	4	12	Peacock 1	Long Beach
C. A. Lawrence-----	13	4	13	1	Long Beach
Marin Corp.-----	19	4	12	25	Long Beach
National Gas Syn.-----	13	4	13	1	Long Beach
National Gas Syn.-----	13	4	13	2	Long Beach
Progressive Syn.-----	19	4	12	3	Long Beach
Rainbow Petroleum Co.-----	28	4	12	Savage 1	Long Beach

OIL FIELD DEVELOPMENT OPERATIONS—Continued.

Company	Sec.	Twp.	Range	Well No.	Field
LOS ANGELES COUNTY—Cont.					
Reliance Home Investment Co.-----	13	4	13	2	Long Beach
Reliance Home Investment Co.-----	13	4	13	3	Long Beach
San Martinez Oil Co.-----	29	4	12	Booth Comm. 7	Long Beach
J. Oscar Smith-----	29	4	12	1	Long Beach
Union Oil Co.-----	30	4	12	Long Beach	
				Comm. 14	Long Beach
The United Oil Co.-----	29	4	12	Denni 4-A	Long Beach
Western Drilling & Producing Co.-----	18	4	12	1	Long Beach
Standard Oil Co.-----	2	2	12	Baldwin 61-A	Montebello
Standard Oil Co.-----	6	2	11	Baldwin 69	Montebello
Standard Oil Co.-----	2	2	12	Howard	
				& Smith 4	Montebello
Standard Oil Co.-----	3	2	12	Whitehead	
				Comm. 1	Montebello
Barnsdall Oil Co.-----	20	3	13	Rosecrans 8	Rosecrans
Big Five Oil Co.-----	18	3	13	2	Rosecrans
Big Five Oil Co.-----	18	3	13	3	Rosecrans
General Petroleum Corp.-----	18	3	13	Vaughn 4	Rosecrans
Julian Petroleum Corp.-----	12	3	14	Moser 1	Rosecrans
Leland Mitchell-----	7	3	13	3	Rosecrans
Union Oil Co.-----	18	3	13	Howard Park 30	Rosecrans
Union Oil Co.-----	18	3	13	Howard Park 31	Rosecrans
Union Oil Co.-----	18	3	13	Howard Park 13	Rosecrans
Associated Oil Co.-----	6	3	11	Dewenter 5	Santa Fe Springs
General Petroleum Corp.-----	5	3	11	Santa Fe 22	Santa Fe Springs
General Petroleum Corp.-----	5	3	11	Santa Fe 23	Santa Fe Springs
Standard Oil Co.-----	5	3	11	South Whittier	
				Comm. 19	Santa Fe Springs
Chanslor-Canfield Midway Oil Co.-----	16	4	14	Del Amo 44	Torrance
Chanslor-Canfield Midway Oil Co.-----	16	4	14	Del Amo 50	Torrance
Chanslor-Canfield Midway Oil Co.-----	16	4	14	Del Amo 55	Torrance
Chanslor-Canfield Midway Oil Co.-----	9	4	14	Del Amo 56	Torrance
Chanslor-Canfield Midway Oil Co.-----	16	4	14	Del Amo 59	Torrance
Chanslor-Canfield Midway Oil Co.-----	16	4	14	Del Amo 60	Torrance
Chanslor-Canfield Midway Oil Co.-----	8	4	14	Del Amo 85	Torrance
Chanslor-Canfield Midway Oil Co.-----	8	4	14	Del Amo 91	Torrance
R. & D. Oil Co.-----	9	4	14	3	Torrance
Central Oil Co.-----	23	2	11	77	Whittier
Lang Wall No. 5-----	16	2	11	5	Whittier
W. E. McCaslin-----	17	2	11	Patton-Gregg 2	Whittier
Supreme Petroleum Corp.-----	16	2	11	Simmons 1	Whittier
Dominguez Extension Oil Co.-----	22	3	13	1	
George W. Johnson-----	32	5	17	Wickham 1	
Marland Oil Co.-----	11	5	12	Bixby 3	
Marland Oil Co.-----	2	5	12	Bixby 4	
Marland Oil Co.-----	10	5	12	Selover 1	
Petroleum Securities Co.-----	18	2	12	Bandini 1	
Rancho Sausal Petroleum Co.-----	1	3	15	Matteson 1	
Smith Petroleum Co.-----	17	3	14	Johnson 1	
Spadra Oil Co.-----	34	1	9	2	
Standard Oil Co.-----	10	5	12	San Gabriel 2	
Clearwater Petroleum Co.-----	16	3	12	1	
ORANGE COUNTY:					
Brea Canon Oil Co.-----	1	3	10	40	Brea Olinda
General Petroleum Corp.-----	1	3	10	Tonner 4-A	Brea Olinda
Shell Co.-----	1	3	10	Fisher 5	Brea Olinda
Shell Co.-----	34	2	10	Puente A-2	Brea Olinda
Union Oil Co.-----	6	3	9	Stearns 65-A	Brea Olinda
Ambassador Petroleum Co.-----	10	6	11	H-B 8	Huntington Beach
Ambassador Petroleum Co.-----	10	6	11	H-B 9	Huntington Beach
Ambassador Petroleum Co.-----	10	6	11	H-B 10	Huntington Beach
Ambassador Petroleum Co.-----	10	6	11	H-B 11	Huntington Beach
H. W. Anthony-----	10	6	11	Lewis Comm. 1	Huntington Beach
H. W. Anthony-----	10	6	11	Schwartz	
				Comm. 1	Huntington Beach
California Petroleum Corp.-----	28	5	11	Buck 2	Huntington Beach

OIL FIELD DEVELOPMENT OPERATIONS—Continued.

Company	Sec.	Twp.	Range	Well No.	Field
ORANGE COUNTY—Cont.					
California Petroleum Corp.-----	10	6	11	Fee 1	Huntington Beach
California Petroleum Corp.-----	10	6	11	Jones 1	Huntington Beach
California Petroleum Corp.-----	10	6	11	Macklin 1	Huntington Beach
California Petroleum Corp.-----	10	6	11	McIntire 1	Huntington Beach
California Petroleum Corp.-----	10	6	11	Plavan Two 1	Huntington Beach
California Petroleum Corp.-----	10	6	11	Sandburg 1	Huntington Beach
California Petroleum Corp.-----	10	6	11	Talbert 1	Huntington Beach
California Petroleum Corp.-----	10	6	11	Tubach 1	Huntington Beach
California Petroleum Corp.-----	10	6	11	Turner 1	Huntington Beach
Frank H. Cole-----	10	6	11	2	Huntington Beach
Frank H. Cole-----	10	6	11	King 1	Huntington Beach
George F. Getty, Inc.-----	10	6	11	H. B. 4	Huntington Beach
George F. Getty, Inc.-----	10	6	11	H. B. 5	Huntington Beach
George F. Getty, Inc.-----	10	6	11	H. B. 6	Huntington Beach
George F. Getty, Inc.-----	10	6	11	H. B. 7	Huntington Beach
George F. Getty, Inc.-----	10	6	11	H. B. 8	Huntington Beach
George F. Getty, Inc.-----	10	6	11	H. B. 9	Huntington Beach
George F. Getty, Inc.-----	10	6	11	H. B. 10	Huntington Beach
George F. Getty, Inc.-----	10	6	11	H. B. 11	Huntington Beach
George F. Getty, Inc.-----	10	6	11	H. B. 12	Huntington Beach
J. Paul Getty-----	10	6	11	Huntington Beach 1	Huntington Beach
J. Paul Getty-----	10	6	11	Huntington Beach 2	Huntington Beach
Globe Lease & Royalty Co.-----	27	5	11	1	Huntington Beach
Guaranty Oil Co.-----	10	6	11	Guaranty 1	Huntington Beach
Hogan and Lytle-----	10	6	11	Lytle 1	Huntington Beach
Hogan and Lytle-----	10	6	11	Lytle 2	Huntington Beach
Huntington Signal Oil Co.-----	10	6	11	5	Huntington Beach
Julian Petroleum Corp.-----	10	6	11	Bristol 1	Huntington Beach
Julian Petroleum Corp.-----	10	6	11	Campbell 1	Huntington Beach
Julian Petroleum Corp.-----	10	6	11	Davis 1	Huntington Beach
Julian Petroleum Corp.-----	7	6	10	Farnsworth 2	Huntington Beach
Julian Petroleum Corp.-----	10	6	11	Lambert 2	Huntington Beach
Julian Petroleum Corp.-----	10	6	11	Plavan 1	Huntington Beach
Julian Petroleum Corp.-----	10	6	11	Stafford 1	Huntington Beach
Julian Petroleum Corp.-----	10	6	11	Stafford 2	Huntington Beach
Julian Petroleum Corp.-----	10	6	11	Stein 1	Huntington Beach
Julian Petroleum Corp.-----	10	6	11	Treat 1	Huntington Beach
Julian Petroleum Corp.-----	10	6	11	Weide 1	Huntington Beach
McKeon Drilling Co., Inc.-----	10	6	11	Albert 1	Huntington Beach
McKeon Drilling Co., Inc.-----	10	6	11	DuBois 1	Huntington Beach
McKeon Drilling Co., Inc.-----	10	6	11	Smith 1	Huntington Beach
The McKeon Oil Co.-----	10	6	11	Huntington 2	Huntington Beach
The McKeon Oil Co.-----	10	6	11	Huntington 3	Huntington Beach
The McKeon Oil Co.-----	10	6	11	Huntington 4	Huntington Beach
Miley-Keek Oil Co.-----	2	6	11	52	Huntington Beach
Miley Oil Co.-----	10	6	11	Pacific Elec. 3	Huntington Beach
Miley Oil Co.-----	10	6	11	Pacific Elec. 4	Huntington Beach
Miley Oil Co.-----	10	6	11	Pacific Elec. 5	Huntington Beach
Miley Oil Co.-----	10	6	11	Pacific Elec. 6	Huntington Beach
Painted Hills Oil Assn.-----	10	6	11	11	Huntington Beach
Petroleum Securities Co.-----	10	6	11	Bonsell 1	Huntington Beach
Petroleum Securities Co.-----	10	6	11	Doyle 1	Huntington Beach
Petroleum Securities Co.-----	10	6	11	Drew 1	Huntington Beach
Petroleum Securities Co.-----	10	6	11	Gibson 1	Huntington Beach
Petroleum Securities Co.-----	10	6	11	Gross 1	Huntington Beach
Petroleum Securities Co.-----	10	6	11	Gross 2	Huntington Beach
Petroleum Securities Co.-----	10	6	11	Lambert 1	Huntington Beach
Petroleum Securities Co.-----	10	6	11	Machris 1	Huntington Beach
Petroleum Securities Co.-----	10	6	11	Montgomery 1	Huntington Beach
Petroleum Securities Co.-----	10	6	11	Parker 1	Huntington Beach
Petroleum Securities Co.-----	10	6	11	Plavan 1	Huntington Beach
Petroleum Securities Co.-----	10	6	11	Tubach 1	Huntington Beach
Petroleum Securities Co.-----	10	6	11	Turner 1	Huntington Beach
Placentia Richfield Central Oil Co.-----	10	6	11	Dabney 1	Huntington Beach
Prudential Oil Corp.-----	10	6	11	Stone 1	Huntington Beach
Ring Petroleum Co.-----	10	6	11	6	Huntington Beach
Fred W. Roberts-----	10	6	11	H. B. 1	Huntington Beach

OIL FIELD DEVELOPMENT OPERATIONS—Continued.

Company	Sec.	Twp.	Range	Well No.	Field
ORANGE COUNTY—Continued.					
Standard Oil Co.	10	6	11	Anderson 1	Huntington Beach
Standard Oil Co.	34	5	11	Bolsa 26	Huntington Beach
Standard Oil Co.	10	6	11	Crawford 1	Huntington Beach
Standard Oil Co.	10	6	11	Crawford 2-1	Huntington Beach
Standard Oil Co.	10	6	11	Fee 1	Huntington Beach
Standard Oil Co.	3	6	11	Huntington B 51	Huntington Beach
Standard Oil Co.	10	6	11	Huntington B 52	Huntington Beach
Standard Oil Co.	10	6	11	Huntington B 53	Huntington Beach
Standard Oil Co.	10	6	11	Huntington B 54	Huntington Beach
Standard Oil Co.	10	6	11	Huntington B 55	Huntington Beach
Standard Oil Co.	10	6	11	Huntington B 56	Huntington Beach
Standard Oil Co.	10	6	11	Huntington H 1	Huntington Beach
Standard Oil Co.	10	6	11	Huntington H 2	Huntington Beach
Standard Oil Co.	10	6	11	Huntington H 3	Huntington Beach
Standard Oil Co.	10	6	11	Huntington H 4	Huntington Beach
Standard Oil Co.	10	6	11	Huntington H 5	Huntington Beach
Standard Oil Co.	10	6	11	Huntington H 6	Huntington Beach
Standard Oil Co.	10	6	11	Huntington H 7	Huntington Beach
Standard Oil Co.	10	6	11	Huntington H 8	Huntington Beach
Standard Oil Co.	10	6	11	Huntington H 9	Huntington Beach
Standard Oil Co.	10	6	11	Huntington H 10	Huntington Beach
Standard Oil Co.	10	6	11	Huntington H 11	Huntington Beach
Standard Oil Co.	10	6	11	Huntington H 12	Huntington Beach
Standard Oil Co.	10	6	11	Huntington H 13	Huntington Beach
Standard Oil Co.	10	6	11	Huntington H 14	Huntington Beach
Standard Oil Co.	10	6	11	Huntington H 15	Huntington Beach
Standard Oil Co.	10	6	11	Huntington H 16	Huntington Beach
Standard Oil Co.	10	6	11	Huntington H 17	Huntington Beach
Standard Oil Co.	10	6	11	Huntington H 19	Huntington Beach
Standard Oil Co.	10	6	11	P. E. 1	Huntington Beach
Standard Oil Co.	4	6	11	P. E. 2	Huntington Beach
Standard Oil Co.	12	6	11	Thomson 8	Huntington Beach
Standard Oil Co.	10	6	11	Vickers 1	Huntington Beach
Superior Oil Co.	10	6	11	Babbitt 1	Huntington Beach
Superior Oil Co.	10	6	11	Chudnow 1	Huntington Beach
Superior Oil Co.	10	6	11	Fee 1	Huntington Beach
Superior Oil Co.	10	6	11	Fee 2	Huntington Beach
Superior Oil Co.	10	6	11	Fee 3	Huntington Beach
Superior Oil Co.	10	6	11	Fee 4	Huntington Beach
Superior Oil Co.	10	6	11	Gillette 6 1	Huntington Beach
Superior Oil Co.	10	6	11	Gillette 7 1	Huntington Beach
Superior Oil Co.	10	6	11	Gillette 7 2	Huntington Beach
Superior Oil Co.	10	6	11	Gilmore 1	Huntington Beach
Superior Oil Co.	10	6	11	Jones 2	Huntington Beach
Superior Oil Co.	10	6	11	Levinson 1	Huntington Beach
Superior Oil Co.	10	6	11	Nixon 1	Huntington Beach
Superior Oil Co.	10	6	11	Schwartz 1	Huntington Beach
Superior Oil Co.	10	6	11	Stever 1	Huntington Beach
Superior Oil Co.	10	6	11	Scouler 1	Huntington Beach
The United Oil Co.	10	6	11	Buck 1	Huntington Beach
The United Oil Co.	10	6	11	Van 1	Huntington Beach
The United Oil Co.	10	6	11	Ward 1	Huntington Beach
United States Royalties Co.	10	6	11	Stein 1	Huntington Beach
Wilshire Oil Co., Inc.	10	6	11	H-B 3	Huntington Beach
Wilshire Oil Co., Inc.	10	6	11	H-B 4	Huntington Beach
Wilshire Oil Co., Inc.	10	6	11	H-B 5	Huntington Beach
Wilshire Oil Co., Inc.	10	6	11	H-B 6	Huntington Beach
Wilshire Oil Co., Inc.	10	6	11	H-B 7	Huntington Beach
Wilshire Oil Co., Inc.	10	6	11	H-B 8	Huntington Beach
Wilshire Oil Co., Inc.	10	6	11	H-B 9	Huntington Beach
Wilshire Oil Co., Inc.	10	6	11	H-B 10	Huntington Beach
Woolner Oil Corp.	2	6	11	H-B 1	Huntington Beach
Bar-Mor Petroleum Corp.	21	6	10	2	Newport
Jordan & Maney	21	6	10	Costa Mesa 1	Newport
J. J. Rekar	21	6	10	4	Newport
Associated Oil Co.	28	3	9	Bayha 1-A	Richfield
California Petroleum Corp.	34	3	9	Richfield	Richfield
				Cons. 12	Richfield

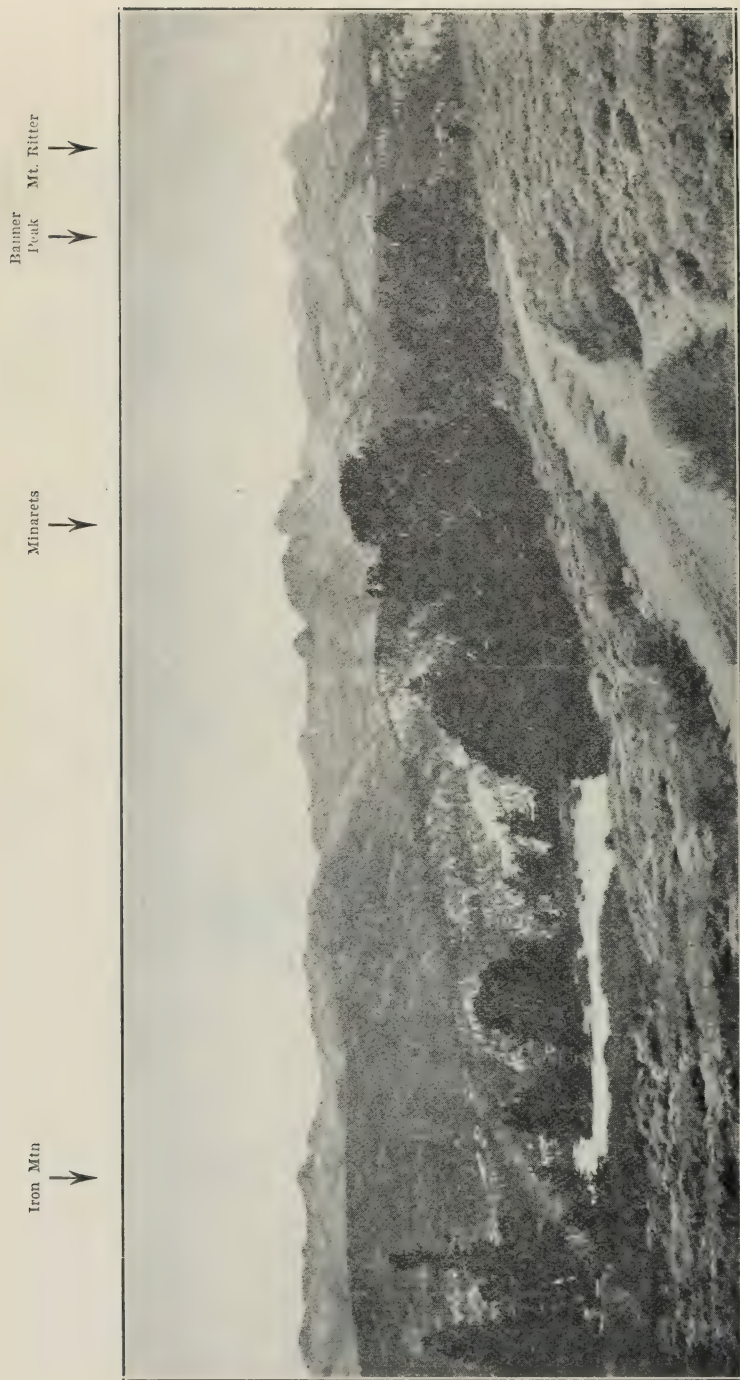
OIL FIELD DEVELOPMENT OPERATIONS—Continued.

Company	Sec.	Twp.	Range	Well No.	Field
ORANGE COUNTY—Continued.					
California Petroleum Corp.-----	28	3	9	Yarnell 21	Richfield
California Petroleum Corp.-----	29	3	9	Yarnell 22	Richfield
Chanslor-Canfield Midway Oil Co.---	28	3	9	5-R	Richfield
Chanslor-Canfield Midway Oil Co.---	33	3	9	Richfield 6	Richfield
Chiksan Oil Co.-----	32	3	9		Richfield
Chiksan Oil Co.-----	33	3	9	Heartwell 1	Richfield
General Petroleum Corp.-----	33	3	9	Hugo 4	Richfield
General Petroleum Corp.-----	33	3	9	Hugo 5	Richfield
General Petroleum Corp.-----	28	3	9	Stern 7	Richfield
General Petroleum Corp.-----	28	3	9	Stern 8	Richfield
General Petroleum Corp.-----	28	3	9	Stern 9	Richfield
General Petroleum Corp.-----	29	3	9	Thompson 8	Richfield
General Petroleum Corp.-----	28	3	9	Thompson 9	Richfield
S. H. Keoughan, trustee.-----	30	3	9	Kraemer-	
				Keoughan 3	Richfield
Standard Oil Co.-----	29	3	9	Kraemer 28	Richfield
Union Oil Co.-----	28	3	9	Thompson &	
				Goodwin 7	Richfield
Union Oil Co.-----	33	3	9	Yorba Linda	
				Group 12	Richfield
Associated Oil Co.-----	11	5	12	Bryant 1	Seal Beach
Standard Oil Co.-----	3	5	12	San Gabriel 1	Seal Beach
SAN BENITO COUNTY:					
Homestake Oil Co.-----	14	17	11	3	-----
SAN BERNARDINO COUNTY:					
Hal R. Bourne.-----	31	2	8	1	-----
SAN DIEGO COUNTY:					
Torrey Pines Oil Co.-----	18	14	3	1	-----
SAN LUIS OBISPO COUNTY:					
E. G. Starr.-----	9	27	13	1	-----
SANTA BARABARA COUNTY:					
Palmer Union Oil Co.-----	30	9	32	Stendel 8	Cat Canyon
R. & G. Oil Co.-----	30	9	32	6	Cat Canyon
Smith & Barmore.-----		4	26	3	Summerland
West Penn Producing Co.-----		8	31	Shields 2	-----
SANTA CLARA COUNTY:					
R. H. Shannon.-----	8	9	1	New Moody 4	Moody Gulch
TULARE COUNTY:					
Ozena Oil Co.-----	26	24	24	1	-----
Wm. C. Resser.-----	14	24	27	Zimmerman 1	-----
John Walklin.-----	35	24	24	Walklin-	
				Delano 19	-----
VENTURA COUNTY:					
Montebello Oil Co.-----	4	3	19	Shiells 115	Bardsdale
Hartkopf & Thomson.-----	33	2	20	1-P	Conejo
A. H. Bradford and W. H. Geis,					
Trustees.-----	21	4	22	1	Ojai
Bell View Oil Syn.-----	1	4	18	1	Piru
Continental Oil Co.-----	22	5	18	Burnham 1	Piru
W. H. Geis.-----	2	3	18	1	Piru
W. H. Geis.-----	36	4	18	2	Piru
Wrenn et al.-----	17	4	18	8	Piru
Oak Ridge Oil Co.-----	13	3	21	Harvey 20	South Mountain
Oak Ridge Oil Co.-----	18	3	20	Willard 20	South Mountain
Santa Paula Oil Co.-----	18	3	20	Santa Paula 21	South Mountain
Associated Oil Co.-----	22	3	23	Hartman 4	Ventura
Associated Oil Co.-----	27	3	23	Lloyd 19	Ventura
Associated Oil Co.-----	28	3	23	Lloyd 37	Ventura
Associated Oil Co.-----	27	3	23	Lloyd 41	Ventura
Associated Oil Co.-----	27	3	23	Lloyd 43	Ventura

OIL FIELD DEVELOPMENT OPERATIONS—Continued.

Company	Sec.	Twp.	Range	Well No.	Field
VENTURA COUNTY—Continued.					
Bolsa Chica Oil Co.-----	21	3	23	Louis	
General Petroleum Corp.-----	28	3	23	Hartman 2	Ventura
General Petroleum Corp.-----	21	3	23	Barnard 5-A	Ventura
General Petroleum Corp.-----	28	3	23	Barnard 8	Ventura
Shell Co.-----	28	3	23	Notten 11	Ventura
Shell Co.-----	28	3	23	Edison 11	Ventura
Shell Co.-----	28	3	23	Edison 12	Ventura
Shell Co.-----	28	3	23	Edison 13	Ventura
Shell Co.-----	28	3	23	Gosnell 23	Ventura
Shell Co.-----	28	3	23	Taylor 15	Ventura
Ventura Associates Oil Co.-----	21	3	23	Hisey 1	Ventura
Oil Exploration Co.-----	16	5	18	Janes 1	-----
Standard Oil Co.-----	18	2	22	McGrath 1	-----
Standard Oil Co.-----	17	2	22	Montalvo 1	-----





Panoramic view of the Minarets District and the Ritter Range, from Minaret Pass looking westerly across cañon of Middle Fork of San Joaquin River. Cañon in left middle is Minaret Creek.

SPECIAL ARTICLES.

Detailed technical reports on special subjects, the result of research work or extended field investigations, will continue to be issued as separate bulletins by the Bureau, as has been the custom in the past.

Shorter and less elaborate technical papers and articles by members of the staff and others are published in each number of 'Mining in California.'

These special articles cover a wide range of subjects, both of historical and current interest; descriptions of new processes, or metallurgical and industrial plants, new mineral occurrences, and interesting geological formations, as well as articles intended to supply practical and timely information on the problems of the prospector and miner, such as the text of new laws and official regulations and notices affecting the mineral industry.

THE MINARETS DISTRICT, MADERA COUNTY.

By WALTER W. BRADLEY, Deputy State Mineralogist.
With photographs by the author.

Introduction.

The region generally referred to as the Minarets District is at the extreme northeast end of Madera County, at the headwaters of San Joaquin River on the Sierra Nevada divide, southeast from Mt. Lyell. It has also been known as the 'North Fork Mining District',¹ although the important portions of it from a mineral resources standpoint are not on the North Fork, but on the Middle Fork of San Joaquin River. The line of sharp, jagged peaks known as the Minarets form one of the interesting and strikingly scenic features of the Ritter Range, a spur of the main Sierra Nevada crest between the north and middle forks of San Joaquin River. They practically dominate the scenery and command one's attention and admiration at every angle of view. For these reasons the present writer prefers the designation 'Minarets District' to any other that may have been applied. Elevations in the area range from 7500 feet at the lower end of Soda Springs Meadow on the Middle Fork to 13,156 feet above sea level at the summit of Mt. Ritter.

Owing to a proposal on the part of the National Park administration and certain others interested in the recreational features of the region to place this area within the boundaries of the Yosemite National Park, the State Mineralogist directed the writer to make an examination of the district with the particular object of determining what mining activity was being carried on there at present, bringing down-to-date the information in the Bureau's files on the mineral resources of the region. In company with Mr. H. A. Van Loon, manager of the Interstate Telephone and Telegraph Company and secretary of the Bishop Chamber of Commerce, a reconnaissance was made the first week in September of most of the present-day mining claims. A detailed geological study was not attempted for lack of time, the primary object being to ascertain the extent of actual mining development at present

¹ Preston, E. B., North Fork Mining District of Fresno County: Cal. State Min. Bur., Report XI, pp. 218-223, 1892.

being carried on. We were accompanied the first three days by Mr. Bert Butler, who is interested in claims at Agnew Meadows, and the writer wishes here to acknowledge his appreciation of the courtesy and cooperation not only of Messrs. Van Loon and Butler, but of the other operators or claim holders who assisted him, particularly Messrs. Lou R. Johnston, David Nidever, James Sullivan, and S. M. Mingus.

Summary.

Summarizing the data, details of which follow, it was found that there are at least 75 active valid mining claims in 18 groups within the area involved. Some of these claims have been either located or 'relocated' within the last year or two, while on others annual assessment work has been regularly maintained for the past 19 years. At the time of our visit an option had just been given to an important group of Utah



The Minarets. East face as seen from head of Shadow Creek. Note crevasses in glacier.

mining men involving a consideration of nearly a half million dollars and covering a consolidation of three groups of contiguous claims on Shadow and Minaret creeks.

Confirming previous reports on the district by engineers of the California State Mining Bureau (specifically by Preston² and Mohr³), as well as private reports, the writer found that there is a very definite, mineralized belt east of the Ritter Range, extending northerly through T. 4, 3, and 2 S., R. 26 E., M. D. M., from the vicinity of King Creek and Iron Mountain (see U. S. Geol. Survey, Mt. Lyell Quadrangle) in Madera County to Gull Lake in Mono County. The mineral lodes are in more or less parallel series and in general strike northwesterly. Prospecting and development operations thus far have disclosed com-

² *Idem.*

³ Mohr, Paul F., The Minaret region: Unpublished MS. in files of Cal. State Min. Bur., April, 1909.

mercially valuable deposits of lead, silver, zinc, and copper ores. These explorations show that there are large bodies of milling-grade ores with occasional high-grade shoots carrying values running as high as \$50 per ton in silver plus the lead, zinc, or copper content as the case may be.

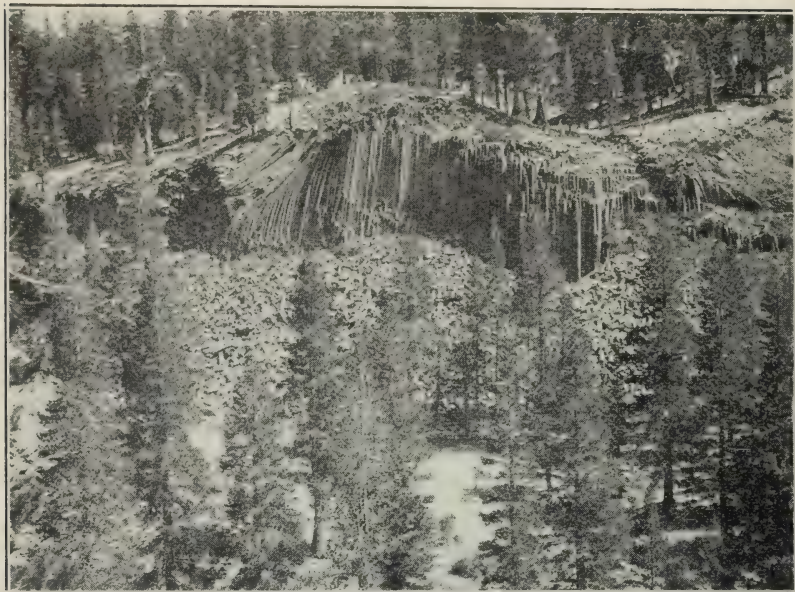
Transportation.

The main drawback to the development of the district has been the lack of transportation facilities. Previous expeditions have approached the district and the transport question from the west. The writer was agreeably surprised to find the solution of this question to be much nearer a reality than is generally thought of or known. For the mineral belt east of the Minarets divide, the logical approach is from the *east*. There is at present an automobile road (52 miles to Bishop) to Minaret Pass, which is being extended by several of the mining claim operators into Agnew Meadows, with only about a mile and a half yet to go, on an easy grade. This will bring auto-truck transportation right to the doors of the claims in and along the side of Agnew Meadows, and to within only three miles (air-line distance) of the Shadow Creek-Minaret Creek groups under option to Utah capital. There is also an auto road to Mammoth Pass.

It does not appear that there are high-grade orebodies of sufficient size or extent to warrant any expectation of developing shipping-grade ore in quantity; but there are extensive bodies of milling-grade ore. Although it is a region of heavy winter snowfall, it is not impractical to conduct mining and ore-dressing operations throughout the year under such conditions, as has been proved in Colorado at elevations of from 10,000 to 12,000 feet above sea-level. In this area, on and tributary to the Middle Fork of San Joaquin River, the economic solution would seem to be to build aerial tramways from the mines to milling plants on the river, and then haul the concentrates by auto-truck to the railroad on the east for shipment to the smelters. Electric power is available from the Silver Lake plant of the Southern Sierras Power Company only five miles to the north of Shadow Lake.

Objections to Proposal to Place Within Yosemite National Park.

So far as the proposal to place this area within the Yosemite National Park is concerned "to protect the natural beauties and the recreational features of the region," those features are amply taken care of under the National Forest regime. It is within the boundaries of the Sierra National Forest. So far as sheep grazing is concerned, of which complaint has been made by the recreationists and nature lovers, the time is fast approaching when all of the feed available in that particular region will be required for the saddle and pack animals of recreationists, fishermen, and miners, and the Forestry administration has ample authority to reserve it for them, excluding the sheep, without the necessity of resorting to National Park status. So far as any water-power development on Shadow Lake is concerned, the catchment and impounding area is too small to be of much economic value. So we feel that there should be no worry on that score, of spoiling the beauty of the lake. From a park administrative standpoint, the summit of the main Sierran divide is an almost impassible barrier (at least, impracticable), the area in question being accessible from the main Yosemite Park headquarters or even the Tuolumne Meadows ranger station,



The Devil Post Pile. One of the world-famous examples of basaltic columns. On the Middle Fork of the San Joaquin River, eastern Madera County. A 'National Monument.'



Glaciated surface on top of basaltic columns at Devil Post Pile. Resembles a tiled pavement. Direction of ice flow from left to right (note striae).

only via the difficult Donohue Pass. The Devil Post Pile is already protected as a National Monument.

There does not exist today any valid reason for putting this section into the Yosemite National Park that was not put forth twenty-two years ago when the area was segregated from the park on account of its mineral values. On the other hand, the reasons for excluding it from the park are even stronger today because of the increased economic value of those mineral resources, their present state of development, and the proximity of transportation which will soon make them commercially available.



Cañon of Middle Fork of San Joaquin River looking southeasterly from Shadow Lake trail. Mammoth Mountain in distance. Agnew Meadows at left of lower point of ridge in center.

As was said by the special commission⁴ which in August, 1904, reported on this same area and on whose report the revised boundaries of Yosemite National Park were fixed in the act of February 7, 1905:

"Nearly all of this territory is mineral bearing, some of it of great value. Many claims have been taken up. In some portions parties are desirous of resuming work if they can only overcome the difficulties which the park throws in their way. There are no important forests in this region, and what there are can be placed in a forest reserve. The scenery is of that grand and permanent character which can not be impaired by the works of man. The divide is an excellent natural boundary which leaves little if any mineral land to the west. * * * The line will be easy to guard because it can be crossed only by well-known passes."

⁴ See Senate Doc. 34, 3d Session, 58th Congress, p. 8, Feb. 1905.

By the act of Oct. 1, 1890, this area with others on the north and west was included within the boundaries of the Yosemite National Park. A considerable number and area of private holdings were included, both mineral and agricultural, also timber. Because of the administrative difficulties which arose from these inclusions and the agitation for a revision of the boundary lines, a special commission was appointed under the Secretary of the Interior to make a survey of the situation and report to Congress as to the advisability of changing the park limits. The commission was composed of Maj. Hiram M. Chittenden, Corps of Engineers, U. S. A.; Mr. Robt. B. Marshall, Topographer, U. S. Geological Survey; and Mr. Frank Bond, Chief of Drafting Division, U. S. General Land Office.



The Minarets, Ritter Range, and a portion of west side of cañon of Middle Fork of San Joaquin River, looking westerly from Sullenger (Tom Agnew) group of claims. Shadow Lake and cañon of Shadow Creek in center. Note dark and light bands indicating mineralized zones. The Nidveer group of claims is at the head of Shadow Creek, in the dark zone just in front of the Ritter Range.

Although all valid existing mining locations would be respected if enclosed within the park limits, yet that introduces elements of irritation. Following passage of the act of October 1, 1890, most of the claim holders became discouraged and left the region. Mr. James Sullenger, now developing the former Agnew group, was at that time interested in the ground now covered by the Nidever claims on Shadow Creek. He informs the writer that an option had been given to London capital for their development; but they dropped the deal when the ground was put into the park. It is hoped that history will not repeat itself as a result of the present proposal to enlarge the park. Again quoting the former commission:⁵

"National parks and forest reservations.—A national park is a much more fixed and rigid institution than a forest reserve. The park is a specific statutory creation. It can be changed only by legislative action. * * * It is generally set apart because of some great natural attraction or historic event. *
*"The forest reserve, on the other hand, is a creature of Executive proclamation, pursuant to a general act of Congress. By the same process it can be changed or annulled altogether. * * * The Secretary of the Interior has a wide latitude in the granting of privileges on the reserved lands, such as the right to open up mines, cut timber, take out ditches, graze cattle, build roads, etc. In other words, the forest reserve gives sufficient protection to save the timber lands from destruction and at the same time does not impede the proper development of many of the natural resources.*

* * * * *

"Reason for excluding certain lands.—The primary reason for cutting off any portion of the park is the fact that there are a great many private claims within it. * * * over which the Government could exercise no control, and to the owners of which it was bound to grant the necessary privileges to develop their property. *
*"The result of this situation has been a great deal of embarrassment to the administration of the park and a large degree of wrong to private owners. The administrative authority is constantly beset with appeals for privileges which are incompatible with the best interests of the reservation and finds it a difficult matter to permit private owners to work their properties and at the same time protect the adjacent lands. * * * and the denial of these privileges, or the granting of them, under restrictions that practically amount to a denial, virtually compels them to abandon the development of their property. This applies with particular force to small, isolated property holders who have no clear conception of their rights nor the resources to enforce them if they had.*

* * * * *

*"It is manifest that such a condition of things is very undesirable within a national park. * * *
 "It (the commission) has also felt that there should be removed as far as possible those sources of temptation which are a constant menace to the existence of the park, such as mineral lands and other valuable resources. Timber and agricultural lands, if owned by the Government, can be protected, but it is difficult to resist the pressure for the exploitation of mineral lands. Even if the Government were to buy up all mining claims within the park, if such a course were practicable, there would still be the knowledge of the presence of precious metals in these mountains, and this would form a temptation of the strongest kind to trespass on the reservation and seek to cut it to pieces."*

At the conclusion of the above-quoted report, and following a letter from the Sierra Club recommending an enlargement of the park boundaries rather than curtailment, the commission added a further memorandum, saying in part:

"The line proposed by the Commission will be far easier to protect than that proposed by the club. Valuable mineral lands will be excluded, the scenery will not be injured, for it is on too large a scale, and the forests will be protected in a forest reserve. The extension of the boundaries, as proposed by the Sierra Club, would include the Tioga mines, a large number of private holdings, and the mining town of Mammoth, and would create new complications in the east of the park like those which it is sought to get rid of in the west."

⁵ *Idem*, pp. 5-6.

MINERAL LOCATIONS.

The accompanying map shows the approximate positions of the various groups and claims at present held on mineral locations in the dis-

trict. They are not to scale, hence positions and sizes are approximate only. The numbers designate the following:

1. Nidever group (Crown Point-Fortuna-Tal Vez).
2. Johnston group (including Beasore).
3. Sullenger (Tom Agnew) group.
4. Butler, et al.
5. Heriford, et al.
6. Heriford, Butler, et al.
7. Heriford, Butler, et al. (Shohawk Mine).
8. Sam's Dream and Hatchet claims-Mingus (molybdenum).
9. Cochran, et al.
10. Alta claim-Mingus, et al.
11. Saddle claim-Mingus, et al.
12. Blue Bird claim-Mingus, et al.



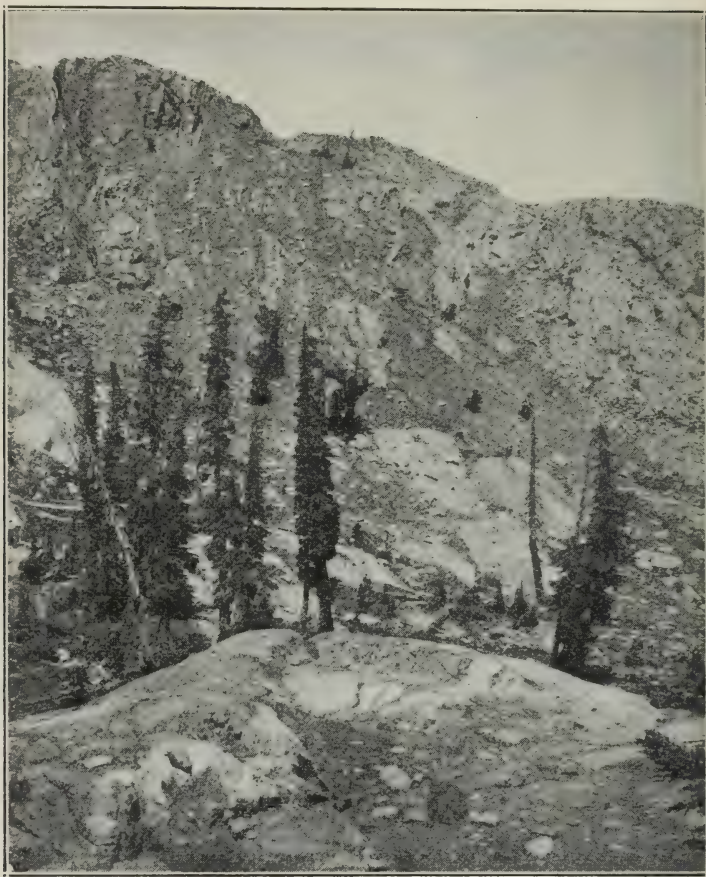
Upper (north) end of Nidever group—Crown Point No. 1 Claim. Ridge marks divide between Shadow Creek and Garnet Lake. Dark bands are mineralized lodes, values at this section being zinc-silver and lead-silver with some copper.

13. Silver Reef claim-Mingus, et al.
14. Cochran, et al.
15. Shadow claim-Mingus, et al.
16. Waage group.
17. Cranmer.
18. Bliss.
19. Barcroft.
20. Kennedy.

The descriptions that follow are taken up in the order of the foregoing numbers.

Nidever Group. This group consists of the Crown Point, Fortuna, and Tal Vez (Spanish for "perhaps") groups, a total of nine claims, which for convenience we have referred to as the 'Nidever group.'

Owners, David C. Nidever, Bishop, Cal. and Myron Folsom, San Francisco. The Crown Point group is on the north side near the head of Shadow Creek and extends from the Shadow Creek-Garnet Lake divide down to the creek. The Fortuna and the Tal Vez groups adjoin the Crown Point claims on the south, extending up the south wall of the cañon to the Shadow Creek-Minareet Creek divide. The Tal Vez claims are parallel to and on the west side of the Fortuna claims. The claims on the north side (Crown Point) were originally known as the 'Cas-



Lead-silver-copper veins on Crown Point Claim (Nidever group) on north side of Shadow Creek. Note tunnel dump in right center. A fault at foot of bluff throws the veins about 200 feet to southeast (right).

cade,' and were relocated by Nidever in 1912. Those on the south side of Shadow Creek were relocated in 1909.

At the north end, the ore values are in zinc, lead and copper, with some silver. There are high-grade shoots of massive sphalerite carrying up to 60% zinc. Specimens of this ore have been placed in the State Mining Bureau's collection. There are also shoots of galena; and copper sulphides (mostly chalcopyrite) are associated with both. The orebodies

occur in silicified limestone between rhyolite (?) walls. Although the limestone is mostly silicified, occasional patches of unaltered limestone were noted. Associated epidote and garnet are abundant in places. The course of the ore zone is N. 35° W., dip northeast nearly vertical; and the width is up to 150 feet. The ore-shoots rake to the southeast, with bodies of milling-grade ore between the higher-grade shoots. Surface oxidation appears to be shallow, extending only a few inches



South end of Fortuna Claim (Nidever group) on south side of Shadow Creek. Joins Johnston group at top of ridge (see photo on page 550.) Looking southerly along mineralized zone.

in depth at most. On Crown Point No. 1 claim there is a shaft 20 feet deep, and several shallow open cuts. Two diamond-drill holes have been put in, both showing ore. One put down near the shaft at an angle of 45° is stated to have shown good ore at 250 feet below the shaft.

On the south side of Shadow Creek, in the Fortuna claims, the ore values are mostly in lead with a little zinc, and silver assays are stated to average 1 oz. silver to each per cent of lead. Occasional shoots show



Lower workings (Fortuna Claim of Nidever group) on south side of Shadow Creek. Mainly lead ore with a little zinc. Carries 1 oz. silver per each 1 per cent of lead. Ore zone 200 feet wide, in limestone.



North end of Johnston group (Beasore, et al.) on north side of Minaret Creek. Ridge marks divide between Minaret and Shadow creeks. Johnston and Nidever groups of claims join at notch at left. Ground across full width of picture is mineralized. Elevation 10,000 feet.

silver values up to 50 and 60 ounces per ton. Higher up the slope, shoots of massive sphalerite appear, also shoots of mixed galena and sphalerite. The ore zone on the Fortuna is at least 200 feet wide. Occasional patches of unaltered limestone were also noted here. Still higher up the slope some copper shows. In the Tal Vez claims to the west of the Fortuna, the ore is mainly galena disseminated in limestone. On the whole, the silver values appear to be better in the claims on the south slope of Shadow Creek Cañon than in those on the north side. There are several shallow adits and open cuts on these south-side claims.

At the time of our visit a consolidation had been arranged for with the Johnston group adjoining to the south on Minaret Creek, and options given to a group of Utah mining men following a favorable report from an engineer of national reputation.

Johnston Group. This group consists of 20 claims at the head of Minaret Creek adjoining the Nidever group to the north, and includes California, Pinto, Betty, Lois C., Maud, Minnie, Helen, et al. claims, in part relocations of older claims. For convenience, we have referred to them as the 'Johnston' group. Owners, Lou R. Johnston and sons, Merced, Cal., and Ed. J. Roberts, San Francisco. They also have an option on the *Albino* Claim, owned by Thomas Beasore of Coarse Gold, Cal. There is a conflict between this 'Beasore' claim and certain locations by F. H. Colburn of San Francisco, which cover (in part, at least) the same ground. Both parties have been doing the assessment work the past two or three years.

The ore zone is 150 feet to 250 feet wide, in limestone largely silicified, and between rhyolite walls, strike northwest, dip northeast. The sulphides, mainly galena with some sphalerite and chalcopyrite, make along the cross fractures. There is some epidote also manganese oxide associated as gangue minerals. Samples taken across the full 250 feet width of ore zone south of the shaft on the Beasore are stated to have averaged 1.5% lead and 1.5 oz. silver. At the collar of the shaft, assays showed 42.5% lead, 37 oz. silver, 9.11% zinc, and 3.68% copper across 18 inches. The shaft followed down on this vein which widened to 36 inches at a depth of 15 feet, showing massive, high-grade galena. The writer has placed specimens of this ore in the museum of the State Mining Bureau. Besides this shaft there are a number of open cuts (see photos).

Sullenger (Tom Agnew) Group. This group of nine claims on the east wall of the cañon of the Middle Fork of San Joaquin River north of Agnew Meadows, consists of the Home and Tom Agnew Nos. 1, 2, 3, 4, 5, 6, 7, 8 claims. These claims cover the ground originally held by Tom Agnew, one of the pioneers of this section, and for some years recorder of the 'North Fork Mining District.' Owner, J. R. Sullenger, Keeler, Cal. The mineralized zone here is approximately 3000 feet wide and consists of a series of quartz stringers and ledges in schist or slate. The hanging wall (east) of this zone is slate, and the footwall, rhyolite. The top of the ridge (east) marking the divide between Madera and Mono counties is capped by later, igneous flows (andesite and basalt). The bottom and practically the entire eastern side of the cañon of the Middle Fork and extending to a considerable



Open-cut on Beasore Claim, showing 6 feet of ore assaying 67 oz. silver, 37 per cent lead, with some copper. Note man's head and shoulders in center.



Shaft on Beasore Claim (Johnston group) at head (north side) of Minaret Creek. Sunk on shoot of high-grade lead-silver ore.

distance up the western slope, is covered with light, broken pumice, about an inch being the maximum size of particles. In some places, particularly at Pumice Flat and at Minaret Pass, the material is several feet thick. In the Agnew Meadows section, Preston⁶ describes the following veins and lodes:

Mother Lode, 60 feet wide, in slate.

Homestake, 50 feet wide, between slate and quartzite.

Advance, 60 feet wide, between slate and porphyry.

Silver Queen, 15 feet wide, in black slate.

Fresno, 75 feet wide, between slate and quartzite.

Mountain View, 20 feet wide.

Silver Streak, 15 to 20 feet wide, in slate.



East side of cañon, Middle Fork of San Joaquin River, looking northwesterly from south of and above Agnew Meadows (below trees in foreground). Lines shown by timber are approximately parallel to the strike of the mineral lode. Claims of Sullenger, Butler, Cline, Heriford, Williamson, and Starkweather are in this zone. White streak in left distance is not a waterfall, but a dike.

De Soto, 50 feet wide, in slate.

Black Jack, 50 feet wide, in slate.

These croppings can be traced for several miles along their strike.

"Going north they are covered for quite a distance by an eruptive flow making down to the river across their strike. It is claimed that the De Soto has been traced along the croppings into the old Mammoth Mine, in Mono County.

"The ores from all these veins, as well as from those belonging in this district, but situated on the west bank of the San Joaquin, are silver-bearing quartz, carrying sulphides, carbonates, chlorides, as well as, to a limited extent, gold. Besides the precious metals, lead, copper, iron, and zinc, in combination, are contained in the ores."

⁶ Preston E. B., North fork mining district of Fresno County: Report XI of State Mineralogist, Cal. State Min. Bur., p. 222, 1892.

The ore values in the Agnew group are principally in lead and silver. Sullenger states that Agnew one time shipped 1100 pounds of ore to Selby smelter for which he was paid over \$600 net. For the most part, however, the ore is of milling grade. More development work, in the form of shafts, adits, crosseuts and open cuts, has been done on these claims than on any other group in the district. Some of the original claims were first located as early as 1878.

Extending southeasterly along the cañon face from south of the Sullenger group, but not in a continuous line, a number of claims are being held. The ore values being mainly in lead and silver.

Buck Deer (1 claim), by Heriford, Butler, and Cline.



Wheelbarrow with wooden wheel, found in old adit on one of Tom Agnew claims.

Heriford & Williamson (1 claim). Showing 8 ft. to 10 ft. of lead-silver-bearing quartz in slate.

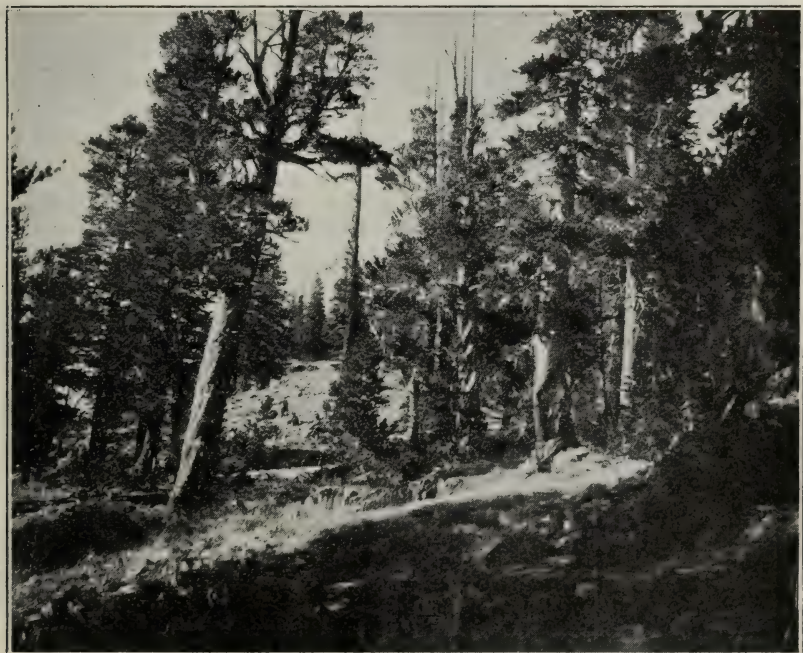
Butler Bros. (1 claim).

Meadow View Group (2 claims), by Heriford, Butler, and Cline, on the northeast side of Agnew Meadows.

Meadow Rose Group (3 claims, No. 1, No. 2, No. 3), by Heriford, Butler and Starkweather. This group is in the ridge on the west side of Agnew Meadows. There is a series of quartz veins covering a width of 35 feet in schist. At one point a shaft has been sunk, showing 8 feet of ore stated to carry 20 oz. to 30 oz. silver in galena. There is



East side of cañon, Middle Fork of San Joaquin River, as seen from above Shadow Lake (in center) looking easterly. Sullenger (Old Tom Agnew) group of claims extend (left to right) along bench noted on face of ridge and below 'Horn' Mountain ('Two Teats,' on map). Top of ridge is capped with igneous flows.



Outcrop of ore zone on Sullenger (Tom Agnew) group, looking northwesterly.

some associated pyrite, also sphalerite. The orebody is mainly of milling grade.

Meadow Rose Extension (1 claim), by Heriford, Butler, and Cline. Also one claim by same locators, east of the cabins at Agnew Meadows.

Crandall & Clark at one time had a group comprising 15 to 20 claims to the south of Sullenger's, but the ground is now stated to be open to location.

Shohawk Mine. This group of 10 claims located by Chas. Heriford, Bert. Butler, of Laws, and Mrs. G. M. Caldwell of Los Angeles, Cal., crosses the divide at Minaret Pass and extends down the slope westward toward the river. There are apparently several different veins in this ground, some showing lead-silver values. Only a small amount of development has thus far been done on them. Because of the blanket of pumice here, the vein outcrops in this section are not so evident as in the other parts of the district.

Sam's Dream and *Hatchet* claims at Dream Lake, located by S. M. Mingus, E. B. Anderson and H. E. Williams of Coalinga, Cal., on a deposit of molybdenite stated to be up to 300 feet in width, with strike northerly.

I. N. Cochran et al., one claim, northwest of and adjacent to Dream claim. Strike of vein northwest.

Alta Claim, parallel to Sam's Dream on west, S. M. Mingus, E. B. Anderson, H. C. Williams, Coalinga, owners. Strike, north.

Saddle Claim, located in a saddle about a mile west of Sam's Dream, by S. M. Mingus, E. B. Anderson, H. C. Williams, Coalinga. Two parallel veins, 4 feet and 20 feet wide, with westerly strike, copper-silver ore.

Blue Bird Claim at the southeasterly end of upper Beck Lake. Mingus, Anderson & Williams, of Coalinga, locators. This covers part of the ground of some of the early Beck locations. Located on a copper-bearing zone 75 feet wide.

Silver Reef Claim, by Mingus, Anderson & Williams of Coalinga. Located parallel to Saddle Claim, on copper-silver vein on a granite and slate contact.

I. N. Cochran et al., one claim, located on a large copper-bearing lode about one-quarter mile south of Beck's cabin. This covers what was probably one of the original Beck locations. Strike of lode, northwest.

Shadow Claim, by Mingus, Anderson & Williams of Coalinga. This claim is on a four-foot vein of copper ore about one-half mile north of the east end of Shadow Lake. Strike, northwest.

Waage Group. John Waage of Etiwanda, Cal., has a group of lead-silver claims on the north extension of the Sullenger group.

Cranmer Group. Cranmer has a group of zinc-silver claims on the north side of Minaret Creek approximately southwest of Shadow Lake, and near the Johnston group.

H. M. Bliss of North Fork has a group of claims on the west side of Banner Peak, stated to carry values up to 50% lead and 50 oz. silver. They are not accessible from the eastern side of the divide, and were not visited by the writer.

Joseph Barcroft of Madera has some claims on the west side of Ritter Mountain, south of and similar to those of Bliss above mentioned. The values are in lead-silver, with 8%-10% zinc.

Joe Kennedy has one or two claims on a copper prospect at 'Lake Superior' (the larger and lower of the two Beck Lakes) near the head of King Creek. This ground was located originally in 1889 by C. J. Beck, who called it *Superior*.

There are *copper* showings on the west side of the cañon near the head of Middle Fork of San Joaquin River, but not at present covered by any known locations, so far as the writer was able to ascertain.

There is a *prospect* on the north side of Shadow Creek a short distance above Shadow Lake, on which some open cut work has been done. The occurrence is of pyrite disseminated in a close-grained, black, igneous dike. Distinctive metal values were not evident on the surface. There may be gold or silver present.

There is an occurrence of *gold-bearing* material on the south side of Minaret Creek at a point about $2\frac{1}{2}$ miles due west from the upper end of Pumice Flat. We were informed that assays of \$2.80 gold per ton had been obtained across a width of 40 feet. The ground is not at present located.

The Mohr report⁷ describes a group of *copper* prospects along the north side of 'Lake Superior' (the larger of the two Beck Lakes), also a group between Lake Superior and Holcomb Lake (to the south). Parts of this ground are apparently covered by the Blue Bird and the Kennedy claims noted above.

Iron ore. It had been our intention on this reconnaissance to have a look at the iron deposits on Iron Mountain at the south end of the Ritter Range spur. Shortness of time and a mishap at Beck Lakes with our pack-mule carrying our food supplies, determined us to take the short-cut down King Creek via Snow Canyon to the Devil Post Pile, and thence back to our automobile, which we had parked at Minaret Pass. The iron ore deposits at Iron Mountain have been described by Weeks⁸ in a report of the Bureau which is still available. The writer has been informed indirectly that title to the present claims located on these deposits is being maintained, but we have not any recent information as to the extent of development work done on them. Their economic utilization will be dependent upon the providing of rail transportation to the westward. Iron Mountain is not included within the boundaries of the proposed Yosemite Park extension, the line swinging from the Minarets southeastward past Beck Lakes to the Devil Post Pile.

⁷ Mohr, P. F., Report on the Minarets region: Cal. State Min. Bur., unpublished MS., 1908.

⁸ Weeks, F. B., The Minaret iron deposit: Cal. State Min. Bur., Report XIV, pp. 555-558, 1914.

ADMINISTRATIVE DIVISION.

WALTER W. BRADLEY, Deputy State Mineralogist.

Personnel.

Mr. Robert L. Keyes, petroleum engineer at Los Angeles in the Department of Petroleum and Gas, has been promoted, effective November 15th, to be deputy supervisor in charge of District 5, stationed at Coalinga, Fresno County, vice V. H. Wilhelm, resigned.

Mr. Forest L. Campbell, librarian of the Bureau, has been transferred to the Department of Petroleum and Gas, as an inspector.

Mr. William E. Dolton, geologist and graduate of University of Southern California, has been appointed to the position of librarian of the Bureau.

New Publications.

During the quarterly period covered by this issue, the following Bureau publications have been made available for distribution:

Mining in California (quarterly), July, 1926, being Chapter 3 of State Mineralogist's Report XXII. Price 25 cents.

Summary of Operations, California Oil Fields: Vol. 11, Nos. 10, 11, and 12, April, May, and June, respectively; also Vol. 12, No. 1, July, 1926.

Commercial Mineral Notes: Nos. 42, 43, 44, Aug.-Oct. (incl.).

These notes carry the lists of 'mineral deposits wanted' and 'minerals for sale' issued in the form of a mimeographed sheet monthly. It is mailed free of charge to those on the mailing list for 'Mining in California.'



DIVISION OF MINERALS AND STATISTICS.

Statistics, Museum, Laboratory.

WALTER W. BRADLEY, Deputy State Mineralogist.

STATISTICS.

Data on the 1925 production of some of California's minerals were given in both the April and July issues of MINING IN CALIFORNIA, and tabulations are presented herein showing the completed totals for all substances for that year grouped by substances and by counties. The complete, detailed annual report on the mineral production of California for 1925 is now available, as Bulletin No. 97 of the State Mining Bureau.

Summary for 1925.

Total value of the mineral output of California for the year of 1925 was \$434,519,660, being an increase of \$59,898,871 over the 1924 total of \$374,620,789. There were fifty-five different mineral substances, exclusive of a segregation of the various stones grouped under gems; and all of the fifty-eight counties of the state contributed to the list.

The salient features of 1925 compared with the preceding year were: The considerable increase in value of the petroleum yield. Material advances were also made by cement, miscellaneous stone, zinc, lead, and quicksilver; while decreases were registered by brick and hollow building blocks and by salt. Gold, copper, silver, and pottery clay fairly well held their own with only slight drops in total value. There were a number of other minor variations. The net result was an increase in the grand total for all groups of practically sixty million dollars, as stated above. Petroleum accounted for an increase of \$55,956,955 in total value, due both to advanced prices, and an increase from 228,933,471 barrels to 232,492,147 barrels in quantity, or a difference of 3,558,676 barrels.

Of the metals: lead increased from 4,984,387 pounds, worth \$398,751, to 7,352,422 pounds, worth \$639,661; zinc from 3,060,000 pounds and \$198,000 to 11,546,602 pounds and \$877,542; quicksilver from 7,948 flasks and \$543,080 to 7,683 flasks and \$621,831; platinum from 273 fine ounces and \$36,452 to 292 fine ounces and \$39,937. Though gold decreased slightly, California continues to account for approximately 30 per cent of the gold output of the United States.

Of the structural group: cement advanced from 11,655,131 barrels, worth \$23,225,850, to 13,206,630 barrels, worth \$25,043,335; granite from a valuation of \$1,211,046 to \$1,853,859. Brick and hollow building blocks or tile decreased in total value from \$9,137,908 to \$7,503,976, due mainly to common brick, though all classes showed drops except fire brick, which advanced slightly in value for a slightly smaller quantity. Lime and magnesite both dropped off slightly. Of the 'industrial' group, as is usually the case, there were a number of fluctuations, mineral water and the sillimanite group being the only ones to show material increases. Of the salines, calcium chloride, potash, and soda increased in value, with the borates, magnesium salts, and common salt decreasing.

By Substances.

The distribution of the 1925 output of California by substances is shown in the following tabulation.

<i>Substance</i>	<i>Amount</i>	<i>Value</i>
Asbestos -----	^a	^a
Bituminous rock -----	^a	^a
Borates -----	46,124 tons	\$1,526,938
Brick and hollow building tile -----		7,503,976
Cement -----	13,206,630 bbls.	25,043,335
Chromite -----	591 tons	10,912
Clay (pottery) -----	537,537 tons	674,376
Coal -----	730 tons	3,880
Copper -----	46,968,499 lbs.	6,669,527
Dolomite -----	42,852 tons	104,900
Feldspar -----	8,165 tons	59,615
Fuller's earth -----	5,280 tons	91,842
Gems -----	-----	10,663
Gold -----	-----	13,065,330
Granite -----	-----	1,853,859
Gypsum -----	107,613 tons	172,444
Lead -----	7,352,472 lbs.	639,661
Lime -----	61,922 tons	685,528
Limestone -----	319,977 tons	494,525
Magnesite -----	64,623 tons	872,944
Magnesium salts -----	4,221 tons	132,553
Manganese ore -----	832 tons	19,450
Marble -----	35,664 cu. ft.	116,105
Mineral paint -----	669 tons	6,969
Mineral water -----	12,115,072 gals.	1,230,455
Natural gas -----	194,719,924 M. cu. ft.	15,890,082
Onyx and travertine -----	19,940 cu. ft.	16,120
Petroleum -----	232,492,147 bbls.	330,609,829
Platinum -----	292 fine oz.	39,937
Potash -----	36,355 tons	829,770
Pumice and volcanic ash -----	5,319 tons	32,937
Pyrites -----	129,500 tons	528,550
Quicksilver -----	7,683 flasks	621,831
Salt -----	284,068 tons	949,826
Sandstone -----	14,704 cu. ft.	14,362
Silica (sand and quartz) -----	12,498 tons	96,780
Silver -----	3,054,416 fine oz.	2,119,765
Soapstone and talc -----	15,465 tons	239,084
Soda -----	48,625 tons	947,649
Stone, miscellaneous ^b -----	-----	17,409,854
Tungsten concentrates -----	573 tons	348,471
Zinc -----	11,546,602 lbs.	877,542
Unapportioned ^c -----	-----	1,957,484
Total value -----		\$434,519,660

^a Under 'Unapportioned.'

^b Includes macadam, ballast, rubble, riprap, paving blocks, sand, gravel and grinding-mill pebbles.

^c Includes calcium chloride, bituminous rock, antimony, asbestos, graphite, infusorial and diatomaceous earth, iron, shale oil, sillimanite-andalusite.

By Counties.

Distribution by counties is given in the following tabulation:

Alameda	\$2,916,506
Alpine	520
Amador	2,625,703
Butte	546,178
Cataveras	1,450,618
Colusa	103,230
Contra Costa	2,544,179
Del Norte	270,582
El Dorado	352,828
Fresno	9,264,996
Glenn	92,288
Humboldt	719,151
Imperial	330,965
Inyo	2,585,145
Kern	89,400,726
Kings	520
Lake	73,348
Lassen	2,404
Los Angeles	193,180,000
Madera	1,377,458
Marin	434,802
Mariposa	634,862
Mendocino	16,533
Merced	80,262
Modoc	2,400
Mono	184,745
Monterey	277,721
Napa	229,172
Nevada	2,352,877
Orange	49,104,490
Placer	550,413
Plumas	4,401,508
Riverside	5,179,108
Sacramento	2,504,405
San Benito	2,617,396
San Bernardino	14,179,663
San Diego	1,129,757
San Francisco	131,158
San Joaquin	737,818
San Luis Obispo	136,477
San Mateo	1,577,513
Santa Barbara	4,338,431
Santa Clara	1,320,858
Santa Cruz	3,227,036
Shasta	4,300,449
Sierra	1,386,301
Siskiyou	219,626
Solano	2,678,547
Sonoma	160,231
Stanislaus	415,466
Sutter	397
Tehama	77,183
Trinity	502,289
Tulare	426,979
Tuolumne	567,248
Ventura	17,853,540
Yolo	23,060
Yuba	2,721,594
Total	\$434,519,660

Total Mineral Production of California, by Years.

The following tabulation gives the total value of mineral production of California by years since 1887, in which year compilation of such data by the State Mining Bureau began. At the side of these figures the writer has placed the values of the most important metal and non-metal items—gold and petroleum.

In the same period copper made an important growth beginning with 1897 following the entry of the Shasta County mines, and more recently Plumas County. Cement increased rapidly from 1902, while crushed rock, sand and gravel as a group parallels the cement increase. Quicksilver has been up and down. Mineral water and salt have always been important items, but the values fluctuate. Borax has increased materially since 1896. War-time increases, 1915–1918, were shown by chromite, copper, lead, magnesite, manganese, silver, tungsten and zinc. Most of these, except silver, have since declined; though structural materials and copper increased in 1920–1924, also lead and magnesite in 1923; lead and zinc in 1925.

Total Mineral Production of California, by Years, Since 1887.

Year	Total value of all minerals	Gold, value	Petroleum, value
1887	\$19,785,868	\$13,588,614	\$1,357,144
1888	19,469,320	12,750,000	1,380,666
1889	16,681,731	11,212,913	368,048
1890	18,039,666	12,309,793	384,200
1891	18,872,413	12,728,869	401,264
1892	18,300,168	12,571,900	561,333
1893	18,811,261	12,422,811	608,092
1894	20,203,294	13,923,281	1,064,521
1895	22,844,663	15,334,317	1,000,235
1896	24,291,398	17,181,562	1,180,793
1897	25,142,441	15,871,401	1,918,269
1898	27,289,079	15,906,478	2,376,420
1899	29,313,460	15,336,031	2,660,793
1900	32,622,945	15,863,355	4,152,928
1901	34,355,981	16,985,044	2,961,102
1902	35,069,105	16,910,320	4,692,189
1903	37,759,040	16,471,264	7,313,271
1904	43,778,348	19,109,600	8,317,806
1905	43,069,227	19,137,043	9,007,820
1906	46,776,085	18,732,452	9,238,020
1907	55,697,949	16,727,928	16,783,943
1908	66,363,198	18,761,559	26,566,181
1909	82,972,209	20,237,870	32,398,187
1910	88,419,679	19,715,440	37,683,542
1911	87,497,879	19,738,908	40,552,088
1912	88,972,385	19,713,478	41,868,344
1913	98,644,639	20,406,958	48,578,014
1914	93,314,773	20,653,496	47,487,109
1915	96,663,369	22,442,296	43,503,837
1916	127,901,610	21,410,741	57,421,334
1917	161,202,962	20,087,504	86,976,209
1918	199,753,837	16,529,162	127,459,221
1919	195,830,002	16,695,955	142,610,563
1920	242,099,667	14,311,043	178,394,937
1921	208,157,472	15,704,822	203,138,225
1922	245,183,826	14,670,346	173,381,265
1923	344,024,678	13,379,013	242,731,309
1924	374,620,789	13,150,175	274,652,874
1925	434,519,660	13,065,330	330,609,829
Total values	\$3,904,915,476	\$641,813,072	\$2,213,747,928

MUSEUM.

The Museum of the State Mining Bureau possesses an exceptionally fine collection of rocks and minerals of both economic and academic value. It ranks among the first five of such collections in North America; and contains not only specimens of most of the known minerals found in California, but much valuable and interesting material from other states and foreign countries as well.

Mineral specimens suitable for exhibit purposes are solicited, and their donation will be appreciated by the State Mining Bureau as well as by those who utilize the facilities of the collection.

The exhibit is daily visited by engineers, students, business men, and prospectors as well as tourists and mere sightseers. Besides its practical use in the economic development of California's mineral resources, the collection is a most valuable educational asset to the state and to San Francisco.

LABORATORY.

FRANK SANBORN, Mineral Technologist.

Inquiries regarding jefferisite mica have recently been received at the State Mining Bureau. Jefferisite belongs to a group of micas called vermiculites. These micas vary in their composition, but their chief characteristic is that upon being heated they give off considerable water and exfoliate, or swell up into very light-weight micaceous aggregates of a light color. The fact that these micas exfoliate when heated has made it possible to commercialize them. The expanded material is utilized in refrigerating insulation, in paints, for wall board, etc.

Jefferisite mica occurs in California, but no large deposits are known to exist. The color of this variety of mica is usually brown or bronze, therefore it could easily be mistaken for biotite. It is possible that some of the deposits of supposedly biotite mica may prove to be jefferisite.

It is evident from the number of samples received that an increased interest has been taken in prospecting during the past year. During the three-month period covered by this report approximately 1350 samples have been received and determined at the laboratory of the State Mining Bureau.

LIBRARY.

WILLIAM E. DOLTON, Librarian.

In addition to the numerous standard works, authoritative information on many phases of the mining and mineral industry is constantly being issued in the form of reports and bulletins by various government agencies.

The library of the State Mining Bureau contains some five thousand selected volumes on mines, mining and allied subjects, and it is also a repository for reports and bulletins of the technical departments of federal and state governments and of educational institutions, both domestic and foreign.

It is not the dearth of the latter publications, but rather a lack of knowledge of just what has been published and where the reports may be consulted or obtained, that embarrasses the ordinary person seeking specific information.

To assist in making the public acquainted with this valuable source of current technical information, 'Mining in California' contains under this heading a list of all books and official reports and bulletins received, with names of publishers or issuing departments.

Files of all the leading technical journals will be found in the library, and county and state maps, topographical sheets and geological folios. Current copies of local newspapers published in the mining centers of the State are available for reference.

The library and reading room are open to the public during the usual office hours, when the librarian may be freely called upon for all necessary assistance.

OFFICIAL PUBLICATIONS RECEIVED.

Governmental.

U. S. Geological Survey:

Professional Papers:

147-B—The Montana Earthquake of June 27, 1925. By J. T. Pardee.

Bulletins:

782 —Ore Deposits of Jerome and Bradshaw Mountain Quadrangle, Arizona. By Waldemar Lindgren.

783-B—Mineral Investigations in Southeastern Alaska. By A. F. Budington.

783-C—Geology and Oil Developments of the Cold Bay District, Alaska. By W. R. Smith.

A Ruby Silver Prospect in Alaska. By S. R. Capps and M. N. Short.

783-D—The Nixon Fork Country and Silver-Lead Prospects Near Ruby. By J. S. Brown.

783-E—Summary of Recent Surveys in Northern Alaska. By P. S. Smith, J. B. Mertie, W. T. Foran.

785-C—Borate Deposits in the Kramer District, Kern County, Cal. By L. F. Noble.

785-D—Note on a Colemanite Deposit near Shoshone, Cal. By L. F. Noble.

786-A—The Geology of the Ingomar Anticline Treasure and Rosebud Counties, Montana. By K. C. Heald.

Water Supply Paper 580-A—Geology of No. 3 Reservoir of the Carlsbad Irrigation Project, New Mexico, with Respect to Water-Tightness. By O. G. Meinzer, B. C. Renick and K. Bryan.

U. S. Bureaus of Mines:

II: 2—Fluorspar and Cryolite in 1925. By H. W. Davis.

II: 28—Cement in 1924. By E. F. Burchard, B. W. Bagley.

Recent Articles on Petroleum and Allied Substances:

July, 1926; August, 1926. By H. Britton.

Technical Paper 364: Permissible Explosives, Mining Equipment, and Apparatus.

Reports of Investigations:

Serial No.:

2743—Coal Mining Royalties and Leasing Conditions in Vermillion and Edgar Counties, Illinois, District VIII. By L. D. Tracy.

2744—Flotation of Limestone from Siliceous Gangue. By Oscar Lee.

2745—Tests and Characteristics of Dust Respirators. By S. H. Katz, G. W. Smith, E. G. Meiter.

2746—Sanitary Survey of the Coal Mines of Alabama. By F. V. Meriwether.

2747—Study of the Reactions in an Iron Blast Furnace. By S. P. Kinney, P. H. Royster, T. L. Joseph.

2748—Consumption of Explosives in March, 1926. By W. W. Adams.

2749—Coal-Mine Fatalities in March, 1926. By W. W. Adams.

2750—Gas Mask for Protection Against Ammonia Gas. By A. C. Fieldner, S. H. Katz, H. W. Frevert.

2751—Nomographic Charts for Computing the Rate of Leakage from Natural Gas Lines. By E. O. Bennett.

2752—Methods of Testing High-Pressure Natural Gas Lines for Leakage Losses. By E. L. Rawlins.

2753—Consumption of Explosives in April, 1926. By W. W. Adams.

2754—Coal-Mine Fatalities in April, 1926. By W. W. Adams.

2755—The Sizing Action of a Coal-Washing Table. By B. M. Byrd.

2756—Subject List of Reports of Investigations Issued During 1925.

2757—Extinction of Methene Flames by Helium. By H. F. Coward and G. W. Jones.

2758—Explosibility of Oil Shale Dust. By V. C. Allison and A. D. Bauer.

2759—Consumption of Explosives in May, 1926. By W. W. Adams.

2760—Coal Mine Fatalities in May, 1926. By W. W. Adams.

2761—Magnetic Concentration of Flue Dust of the Birmingham District. By Oscar Lee, B. W. Gandrud, F. D. De Vaney.

2762—Manufacture of Lime from Small Stone with a Sintering Machine. By W. M. Myers.

2763—Coal-Mine Fatalities in June, 1926. By W. W. Adams.

2764—Consumption of Explosives in June, 1926. By W. W. Adams.

2765—Fourteenth Semi-Annual Motor Gasoline Survey. By E. C. Lane, J. M. Devine, P. Grandone.

2766—Recent Progress in Slate Technology. By Oliver Bowles.

2767—Coal Mine Fatalities in July, 1926. By W. W. Adams.

2768—Consumption of Explosives in July, 1925. By W. W. Adams.

2769—Gas-Making and Fuel Problems of the Gas Industry of California. By Wm. W. Odell.

2770—Additions, Removals and Changes in Permissible List of Explosives from January 1, 1925, to July 31, 1926. By G. St. J. Perrott.

2771—Fluctuations in the Temperature of Natural Gas Flowing in Buried and in Uncovered Pipe Lines. By E. L. Rawlins.

2772—Fatalities in the California Petroleum Industry During the Calendar Year 1925. By H. C. Miller.

2773—Accident-Severity Rates for Certain Metal Mines. By W. W. Adams.

2774—Coal-Mine Fatalities in August, 1926. By W. W. Adams.

2775—Consumption of Explosives in August, 1926. By W. W. Adams.

2776—Hydrogen Sulphide Poisoning in the Texas Panhandle, Big Lake, Texas, and McCamey, Texas, Oilfields. By W. P. Yant and H. C. Fowler.

- 2777—Consumption of Reagents used in Flotation, 1925. By Thomas Varley.
 2778—The Application of Compressed Air to the Elliott Pool, Nowata County, Oklahoma. By Ben E. Lindsly.
 2779—Stream Measurement in Relation to Mine Drainage. By W. R. Crane and E. J. Maust.
 2780—Coal-Mine Royalties and Leasing Conditions in Macoupin, Sangamon, and Montgomery Counties, District VII, Illinois. By L. D. Tracy.
 2781—Coal-Mine Fatalities in September, 1926. By W. W. Adams.
 2782—Consumption of Explosives in September, 1926. By W. W. Adams.

Information Circulars:

- 6004—Record of the Pittsburg Testing Station Standard Dynamite. By S. H. Howell.
 6006—Manufacture and Characteristics of Gasoline. By A. J. Kraemer.
 6007—The Quicksilver Situation from a Domestic Standpoint. By J. W. Furness and R. M. Santmyers.
 6008—Rock Dust Material for Coal Mines. (Forwarding Instructions.)
 60011—The Movement of Oil Through the Panama Canal. By G. R. Hopkins.
 60012—List of Permissible Mining Equipment.

Illinois Geological Survey:

Illinois Petroleum:

- No. 4, August 28, 1926.
 No. 3, July 29, 1926.
 No. 1, April 17, 1926.
 No. 5, October 16, 1926.
 Oil Investigations in the Central Area.
 Report of Investigations No. 11.
 Pleistocene Studies: By M. M. Leighton and Paul MacClintock.

Oklahoma Geological Survey:

- Bulletin 4—Coal in Oklahoma. By C. W. Shannon, et al.
 Bulletin 38—Geology of Beaver County. By C. N. Goud and J. T. Lonsdale.
 Bulletin 39—Geology of Marshall County, Oklahoma. By F. M. Bullard.

Pennsylvania Top. and Geol. Atlas:

- No. 37—Greensburg Quad. By Johnson.
 No. 65—Punxsotawney Quad. By Ashley.
 No. 178—New Holland Quad. By Jonas and Stose.
 No. 206—Allentowne Quad. By Miller.

Alberta Scientific and Industrial Research Council, Sixth Annual Report, 1925.
 Canada Bureau of Mines, Quebec, Department of Colonization, Mines and Fisheries—Mining Operations in Province of Quebec, 1925.

Canada Department of Mines, Mines Branch—No. 632—Bituminous Sands of Northern Alberta. With Maps. By S. C. Ellis.

Ontario Department of Mines:

- 34th Annual Report.
 Bulletin No. 57—Mineral Production of Ontario, 1926 (Jan. 1-June 3).

Ontario Bureau of Mines:

- Vol. V, 1925—Natural Gas and Petroleum in 1925.
 Part VIII, 1925—Igneous Rocks of Sudbury and Their Relation to Ore Deposits.

34th Annual Report, Vol. XXXIV—Part VII, 1925—Geology of Sutton Lake Area, District of Patricia. By J. E. Hawley.

England Geological Survey Memoirs—Wells and Springs of Dorset. By W. Whitaker and W. Edwards.

Japan, Tohoku Imperial University, Sendai—Science Reports, Second Series: Geology. Vol. X, No. 2.

Mexico, Instituto Geologico de Boletin No. 43, 1924.

Anales del Instituto Geologico de—Tomo 11, No. 4, 1926.

Montevideo, Anales del Museo de Historia Natural de—Serie II, Tomo 11, 1926.

New South Wales Department of Mines, Geological Survey Bulletin No. 5—

Antimony, Arsenic, Bismuth, Molybdenum and Tungsten. By E. J. Kenny.
New Zealand:

Bureau of Mines: Geol. Survey Branch, Paleontological Bulletin No. 11. The Cretaceous and Tertiary Foraminifera of New Zealand. By Frederick Chapman.

Department of Internal Affairs: 58th Annual Report of the Dominion Laboratory. By J. S. MacLaurin.

Queensland Department of Mines: The Queensland Geological Survey Report No. 277—A Geological Reconnaissance Between Roma, Springsure, Tambar, Taroom. By H. I. Jensen.

Rio de Janeiro:

Boletim de Museo Nacional de—Vol. II, No. 2, March, 1926.

Annes de Biblioteca Nacional de—1919-20, Vols. XLI-II.

South Australia:

Department of Mines: Bulletin No. 12—Clay and Cement in South Australia. By R. L. Jack, Dep. Gov. Geologist.

Transactions and Proceedings of the Royal Society of South Australia, Vol. XLIX.

U. S. Coast and Geodetic Survey, Serial No. 350—Report on the Readjustment of the First Order Triangulation Net of the Western Part of the United States. By O. S. Adams.

Societies and Educational Institutions.

American Institute of Mining and Metallurgical Engineers—Transactions of, Vol. LXXIII, 1926.

American Peat Society, Journal of, Vol. XIX, Nos. 2 and 3, April and July, 1926.

American Philosophical Society, Proceedings of, Vol. LXV, No. 2; Vol. LXV, No. 3, 1926.

California Academy of Sciences:

Occasional Paper XII—A Review of the Giant Mackerel-like Fishes—Tunnies, Spearfishes and Swordfishes.

Proceedings of Vol. 15, June 3, 1926, Fourth Series.

XII—The Antirrhinoideæ-Antirrhineæ of the New World. By P. A. Munz. Fourth Series, Vol. XV, July 22, 1926.

XIII—Descriptions of Seven Andrenids in the Collection of the California Academy of Sciences. By H. L. Viereck.

XIV—Expedition to the Revillagigedo Islands, Mexico, in 1925, VII. By E. K. Jordan and L. G. Hertlein.

XV—Expedition to the Revillagigedo Islands, Mexico. By W. H. Dall. Fourth Series, Vol. XV, Sept. 15, 1926.

XVI—A Critical Inspection of the Gnatcatchers of the Californias. By J. Grinnell.

Fourth Series, October 10, 1924, Vol. XII, No. 32 and 33, Report XXXII. Report of the President of the Academy for the year 1923. By C. E. Grunsky.

Report XXXIII—Report of the Director of Museum for the year 1923. By B. W. Evermann.

Fourth Series, 1925, Vol. V, No. 6—Tertiary Deposits of Northeastern Mexico. By E. T. Dumble.

Fourth Series, December 30, 1914, Vol. IV, No. 3—Neocene Record in the Temblor Basin, Cal., and Neocene Deposits of the San Juan District in San Luis Obispo County, California. By F. M. Anderson and Bruce Martin.

Fourth Series, July 30, 1917, Vol. VII, No. 4—Stratigraphic and Faunal Relations of the Martinez to the Chico and Tejon of Southern California. By C. A. Waring.

Fourth Series, July 12, 1919, Vol. IX, No. 4—Climatic Relations of the Tertiary and Quaternary Faunas of the California Region. By J. P. Smith.

Fourth Series, July 19, 1918, Vol. VIII, No. 4—The Geology of the Northern End of the Tampico Embayment Area. By E. T. Dumble.

- Engineers' Society of Western Pennsylvania, Proceedings of, Vol. 42, No. 6, July, 1926.
 Institution of Mining and Metallurgy, Bulletin of, No. 265, October 1926; No. 264, September, 1926.
 Mining and Metallurgical Society of America, Proceedings of, Vol. XVIII, 1926. Bulletin 184, June 1926, Vol. XIX, No. 3.
 Western Society of Engineers, Journal of, September, 1926.
 John Crerar Library, 31st Annual Report, 1925.
 Missouri University, School of Mines and Metallurgy—Electrical Precipitation as Applied to Gas Streams. By H. R. Hanley.
 Canadian Institute of Mining and Metallurgy, No. 174, Oct. 1926.
 Trans. Institute of Mining and Metallurgy, London—Vol. 39.

Topographic Maps.

- | | |
|--------------------------|----------------------------|
| Ammon, Idaho. | Pacoima, Cal. |
| Belleville, W. Va.-Ohio. | Mt. Harris, Colo. |
| Bruceton, W. Va.-Pa. | Pounding Mill, Va.-W. Va. |
| Edgehill, Mo. | Randolph, Vt. |
| Elizabeth, W. Va. | Scottsville, Ky. |
| El Monte, Cal. | Stoddard, Wis.-Minn.-Iowa. |
| Greenwood, N. Y. | Sunland, Cal. |
| Maitland, Mo. | Thornton, W. Va. |
| Mitchell, Ore. | Waverly, Ill. |
| Chatsworth, Cal. | Woodhull, N. Y. |
| La Brea, Cal. | |

Current Magazines on File.

For the convenience of persons wishing to consult the technical magazines in the reading room, a list of those on file is appended:

- American Petroleum Institute, New York.
 Architect and Engineer, San Francisco.
 Arizona Mining Journal, Phoenix, Arizona.
 Asbestos, Philadelphia, Pennsylvania.
 Brick and Clay Record, Chicago.
 Bulletin, Union Oil Co., Los Angeles.
 California Journal of Development, San Francisco.
 Cement, Mill and Quarry, Chicago, Illinois.
 Chemical-Engineering and Mining Review, Melbourne, Australia.
 Engineering and Mining Journal-Press, New York.
 Explosives Engineer, Wilmington, Del.
 Financial Insurance News, Los Angeles, California.
 Graphite, Jersey City.
 Journal of Electricity and Western Industry, San Francisco.
 Metallurgical and Chemical Engineering, New York.
 Mine and Quarry, Chicago.
 Mining and Engineering Record, Vancouver, B. C.
 Mining and Oil Bulletin, Los Angeles.
 Oil Age, Los Angeles.
 Oil and Gas Journal, Tulsa, Oklahoma.
 Oil and Gas News, Kansas City.
 Oil News, Galesburg, Illinois.
 Oildom, New York.
 Oil, Paint and Drug Reporter, New York.
 Oil Trade Journal, New York.
 Oil Weekly, Houston, Texas.
 Petroleum Age, New York.
 Petroleum Record, Los Angeles.
 Petroleum World, Los Angeles.
 Queensland Government Mining Journal, Brisbane, Australia.
 Rock Products, Chicago, Illinois.
 Safety News, Industrial Accident Commission, San Francisco.
 Salt Lake Mining Review, Salt Lake City, Utah.
 Southwest Builder and Contractor, Los Angeles.

Standard Oil Bulletin, San Francisco.
Stone, New York.
The Record, Associated Oil Company, San Francisco.
Through the Ages, Baltimore.

Newspapers.

The following papers are received and kept on file in the library:

Amador Dispatch, Jackson, Cal.
Arkansas Oil and Mineral News, Hot Springs National Park (Arkansas).
Barstow Printer, Barstow, Cal.
Blythe Herald, Blythe, Cal.
Bridgeport Chronicle-Union, Bridgeport, Mono Co., Cal
Calaveras Prospect, San Andreas, Cal.
California Oil World, Los Angeles, Cal.
Cloverdale Reveille, Cloverdale, Cal.
Colusa Daily Sun, Colusa, Cal.
Daily Commercial News, San Francisco, Cal.
Daily Midway Driller, Taft, Cal.
Del Norte Triplicate, Crescent City, Cal.
Exeter Sun, Exeter, Cal.
Gateway Gazette, Beaumont, Cal.
Goldfield News, Goldfield, Nevada.
Guerneville Times, Guerneville, Cal.
Healdsburg Enterprise, Healdsburg, Cal.
Humboldt Standard, Eureka, Cal.
Inyo Independent, Independence, Cal.
Inyo Register, Bishop, Cal.
Ione Valley Echo, Ione, Cal.
Lake County Bee, Lakeport, Cal.
Mining and Financial Record, Denver, Colo.
Mining Topics, San Francisco, Cal.
Mountain Democrat, Placerville, Cal.
Mountain Messenger, Downieville, Cal.
Nevada Mining Press, Reno, Nevada.
Oatman Mining News, Oatman, Arizona.
Oregon Observer, Grants Pass, Oregon.
Oroville Daily Register, Oroville, Cal.
Petroleum Reporter, Taft, Cal.
Placer Herald, Auburn, Cal.
Plumas Independent, Quincy, Cal.
Plumas National Bulletin, Quincy, Cal.
Randsburg Times, Randsburg, Cal.
San Diego News, San Diego, Cal.
Shasta Courier, Redding, Cal.
Siskiyou News, Yreka, Cal.
Stockton Record, Stockton, Cal.
Tuolumne Prospector, Tuolumne, Cal.
Ventura Daily Post, Ventura, Cal.
Weekly Trinity Journal, Weaverville, Cal.
Western Sentinel, Etna Mills, Cal.

PRODUCERS AND CONSUMERS.

The producer and consumer of mineral products are mutually dependent upon each other for their prosperity, and one of the most direct aids rendered by the Bureau to the mining industry in the past has been that of bringing producers and consumers into direct touch with each other.

This work has been carried on largely by correspondence, supplemented by personal consultation. Lists of buyers of all the commercial minerals produced in California have been made available to producers upon request, and likewise the owners of undeveloped deposits of various minerals, and producers of them, have been made known to those looking for raw mineral products.

When the publication of MINING IN CALIFORNIA was on a monthly basis, current inquiries from buyers and sellers were summarized and lists of mineral products or deposits 'wanted' or 'for sale' included in each issue.

It is important that inquiries of this nature reach the mining public as soon as possible and in order to avoid the delay incident to the present quarterly publication of MINING IN CALIFORNIA, these lists are now issued monthly in the form of a mimeographed sheet under the title of 'Commercial Mineral Notes.'



EMPLOYMENT SERVICE.

Following the establishment of the Mining Division branch offices in 1919, a free technical employment service was offered as a mutual aid to mine operators and technical men for the general benefit of the mineral industry.

Briefly summarized, men desiring positions are registered, the cards containing an outline of the applicant's qualifications, position wanted, salary desired, etc., and as notices of 'positions open' are received, the names and addresses of all applicants deemed qualified are sent to the prospective employer for direct negotiations.

Telephone and telegraphic communications are also given immediate attention.

The Bureau registers technical men, or those qualified for supervisory positions, and vacancies of like nature, only, as no attempt will be made to supply common mine and mill labor.

A list of current applications for positions and 'positions open' is carried in each issue. Notices are designated by a key number, and the name and address corresponding to any number will be supplied upon request, without delay or charge of any kind. If desired, recommendations may be filed with an application, but copies only should be sent to the Bureau, to avoid possible loss. Registration cards for the use of both prospective employers and employees may be obtained at any office of the Bureau upon request, and a cordial invitation is extended to the industry to make free use of the facilities afforded.

POSITIONS WANTED.

- 41-16 Mining Engineer-Metallurgist or Draftsman. Five years' experience. Age 36. Married. References. Salary wanted, \$175.
- 41-17 Metallurgist or Chemist and Assayer. Fifteen years' experience in lead and copper smelting, hydrometallurgy and electrolytic precipitation. Age 38. Married. Minimum salary, \$175.
- 41-18 Laboratory Work. Nine years' experience as assayer, testing, mill work and in ceramics. Age 35, married. References. Salary wanted, \$175.





PUBLICATIONS OF THE CALIFORNIA STATE MINING BUREAU.

During the past forty-four years, in carrying out the provisions of the organic act creating the California State Mining Bureau, there have been published many reports, bulletins and maps which go to make up a library of detailed information on the mineral industry of the state, a large part of which could not be duplicated from any other source.

One feature that has added to the popularity of the publications is that many of them have been distributed without cost to the public, and even the more elaborate ones have been sold at a price which barely covers the cost of printing.

Owing to the fact that funds for the advancing of the work of this department have often been limited, many of the reports and bulletins mentioned were printed in limited editions which are now entirely exhausted.

Copies of such publications are available, however, in the Bureau's offices in the Ferry Building, San Francisco; New Orpheum Building, Los Angeles; Chamber of Commerce Building, Sacramento; Santa Maria; Santa Paula; Coalinga; Taft; Bakersfield. They may also be found in many public, private and technical libraries in California and other states, and foreign countries.

A catalog of all publications of the Bureau, from 1880 to 1917, giving a synopsis of their contents, is issued as Bulletin No. 77.

Publications in stock may be obtained by addressing any of the offices of the State Mining Bureau and enclosing the requisite amount in the case of publications that have a list price. The Bureau is authorized to receive only coin, stamps or money orders, and it will be appreciated if remittance is made in this manner rather than by personal check.

The prices noted include delivery charges to all parts of the United States. Money orders should be made payable to the State Mining Bureau.

REPORTS.

Asterisks (**) indicate the publication is out of print.

	Price
**First Annual Report of the State Mineralogist, 1880, 43 pp. Henry G. Hanks -----	-----
**Second Annual Report of the State Mineralogist, 1882, 514 pp., 4 illustrations, 1 map. Henry G. Hanks-----	-----
**Third Annual Report of the State Mineralogist, 1883, 111 pp., 21 illustrations. Henry G. Hanks-----	-----
**Fourth Annual Report of the State Mineralogist, 1884, 410 pp., 7 illustrations. Henry G. Hanks-----	-----
**Fifth Annual Report of the State Mineralogist, 1885, 234 pp., 15 illustrations, 1 geological map. Henry G. Hanks-----	-----
**Sixth Annual Report of the State Mineralogist, Part I, 1886, 145 pp., 3 illustrations, 1 map. Henry G. Hanks-----	-----
**Part II, 1887, 222 pp., 36 illustrations. William Ireland, Jr.-----	-----
**Seventh Annual Report of the State Mineralogist, 1887, 315 pp. William Ireland, Jr. -----	-----
**Eighth Annual Report of the State Mineralogist, 1888, 948 pp., 122 illustrations. William Ireland, Jr.-----	-----
**Ninth Annual Report of the State Mineralogist, 1889, 352 pp., 57 illustrations, 2 maps. William Ireland, Jr.-----	-----

REPORTS—Continued.

Asterisks (**) indicate the publication is out of print.

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**Tenth Annual Report of the State Mineralogist, 1890, 983 pp., 179 illustrations, 10 maps. William Ireland, Jr.-----	-----
Eleventh Report (First Biennial) of the State Mineralogist, for the two years ending September 15, 1892, 612 pp., 73 illustrations, 4 maps. William Ireland, Jr.-----	\$1.00
**Twelfth Report (Second Biennial) of the State Mineralogist, for the two years ending September 15, 1894, 541 pp., 101 illustrations, 5 maps. J. J. Crawford-----	-----
**Thirteenth Report (Third Biennial) of the State Mineralogist, for the two years ending September 15, 1896, 726 pp., 93 illustrations, 1 map. J. J. Crawford-----	-----
Chapters of the State Mineralogist's Report, Biennial Period, 1913-1914, Fletcher Hamilton:	
**Mines and Mineral Resources, Amador, Calaveras and Tuolumne Counties, 172 pp., paper-----	-----
Mines and Mineral Resources, Colusa, Glenn, Lake, Marin, Napa, Solano, Sonoma and Yolo Counties, 208 pp., paper-----	.50
Mines and Mineral Resources, Del Norte, Humboldt, and Mendocino Counties, 59 pp., paper-----	.25
**Mines and Mineral Resources, Fresno, Kern, Kings, Madera, Mariposa, Merced, San Joaquin and Stanislaus Counties, 220 pages, paper-----	-----
Mines and Mineral Resources of Imperial and San Diego Counties, 113 pp., paper-----	.35
**Mines and Mineral Resources, Shasta, Siskiyou and Trinity Counties, 180 pp., paper-----	-----
**Fourteenth Report of the State Mineralogist, for the Biennial Period 1913-1914, Fletcher Hamilton, 1915:	
A General Report on the Mines and Mineral Resources of Amador, Calaveras, Tuolumne, Colusa, Glenn, Lake, Marin, Napa, Solano, Sonoma, Yolo, Del Norte, Humboldt, Mendocino, Fresno, Kern, Kings, Madera, Mariposa, Merced, San Joaquin, Stanislaus, San Diego, Imperial, Shasta, Siskiyou, and Trinity Counties, 974 pp., 275 illustrations, cloth-----	-----
Chapters of the State Mineralogist's Report, Biennial Period, 1915-1916, Fletcher Hamilton:	
**Mines and Mineral Resources, Alpine, Inyo and Mono Counties, 176 pp., paper-----	-----
**Mines and Mineral Resources, Butte, Lassen, Modoc, Sutter, and Tehama Counties, 91 pp., paper-----	-----
Mines and Mineral Resources, El Dorado, Placer, Sacramento, and Yuba Counties, 198 pp., paper-----	.65
Mines and Mineral Resources, Monterey, San Benito, San Luis Obispo, Santa Barbara, and Ventura Counties, 183 pp., paper-----	.65
Mines and Mineral Resources, Los Angeles, Orange, and Riverside Counties, 136 pp., paper-----	.50
**Mines and Mineral Resources, San Bernardino and Tulare Counties, 186 pp., paper-----	-----
**Fifteenth Report of the State Mineralogist, for the Biennial Period 1915-1916, Fletcher Hamilton, 1917:	
A General Report on the Mines and Mineral Resources of Alpine, Inyo, Mono, Butte, Lassen, Modoc, Sutter, Tehama, Placer, Sacramento, Yuba, Los Angeles, Orange, Riverside, San Benito, San Luis Obispo, Santa Barbara, Ventura, San Bernardino and Tulare Counties, 990 pp., 413 illustrations, cloth-----	-----
Chapters of the State Mineralogist's Report, Biennial Period 1917-1918, Fletcher Hamilton:	
Mines and Mineral Resources of Nevada County, 270 pp., paper-----	.75
Mines and Mineral Resources of Plumas County, 188 pp., paper-----	.50
Mines and Mineral Resources of Sierra County, 144 pp., paper-----	.50
Seventeenth Report of the State Mineralogist, 1920, Mining in California during 1920, Fletcher Hamilton: 562 pp., 71 illustrations, cloth-----	1.75

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Eighteenth Report of the State Mineralogist, 1922, Mining in California, Fletcher Hamilton. Chapters published monthly beginning with January, 1922:	
**January, **February, March, April, May, June, July, August, September, October, November, December, 1922-----	Free
Chapters of Nineteenth Report of the State Mineralogist, 'Mining in California,' Fletcher Hamilton and Lloyd L. Root. January, February, March, September, 1923-----	Free
Chapters of Twentieth Report of the State Mineralogist, 'Mining in California,' Lloyd L. Root. Published quarterly. January, April, July, October, 1924, per copy-----	\$0.25
Chapters of Twenty-first Report of the State Mineralogist, 'Mining in California,' Lloyd L. Root. Published quarterly.	
January, 1925, Mines and Mineral Resources of Sacramento, Monterey and Orange counties-----	.25
April, 1925, Mines and Mineral Resources of Calaveras, Merced, San Joaquin, Stanislaus and Ventura counties-----	.25
July, 1925, Mines and Mineral Resources of Del Norte, Humboldt and San Diego counties-----	.25
October, 1925, Mines and Mineral Resources of Siskiyou, San Luis Obispo and Santa Barbara counties-----	.25
Subscription, \$1.00 in advance (by calendar year, only).	
Chapters of Twenty-second Report of the State Mineralogist, 'Mining in California,' Lloyd L. Root. Published quarterly.	
January, 1926, Mines and Mineral Resources of Trinity and Santa Cruz counties-----	.25
April, 1926, Mines and Mineral Resources of Shasta, San Benito and Imperial counties-----	.25
July, 1926, Marin and Sonoma counties-----	.25
October, 1926, El Dorado and Inyo counties-----	.25
Chapters of State Oil and Gas Supervisor's Report:	
Summary of Operations—California Oil Fields, July, 1918, to March, 1919 (one volume)-----	Free
Summary of Operations—California Oil Fields. Published monthly, beginning April, 1919:	
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BULLETINS.

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**Bulletin No. 1. A Description of Some Desiccated Human Remains, by Winslow Anderson. 1888, 41 pp., 6 illustrations-----	----
**Bulletin No. 2. Methods of Mine Timbering, by W. H. Storms. 1894, 58 pp., 75 illustrations-----	----
**Bulletin No. 3. Gas and Petroleum Yielding Formations of Central Valley of California, by W. L. Watts. 1894, 100 pp., 13 illustrations, 4 maps-----	----
**Bulletin No. 4. Catalogue of Californian Fossils, by J. G. Cooper, 1894, 73 pp., 67 illustrations. (Part I was published in the Seventh Annual Report of the State Mineralogist, 1887.)-----	----

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**Bulletin No. 5. The Cyanide Process, 1894, by Dr. A. Scheidel. 140 pp., 46 illustrations-----	-----
Bulletin No. 6. California Gold Mill Practices, 1895, by E. B. Preston, 85 pp., 46 illustrations-----	\$0.50
**Bulletin No. 7. Mineral Production of California, by Counties for the year 1894, by Charles G. Yale. Tabulated sheet-----	-----
**Bulletin No. 8. Mineral Production of California, by Counties for the year 1895, by Charles G. Yale. Tabulated sheet-----	-----
**Bulletin No. 9. Mine Drainage, Pumps, etc., by Hans C. Behr. 1896, 210 pp., 206 illustrations-----	-----
**Bulletin No. 10. A bibliography Relating to the Geology, Palæontology and Mineral Resources of California, by Anthony W. Vogdes. 1896, 121 pp.-----	-----
**Bulletin No. 11. Oil and Gas Yielding Formations of Los Angeles, Ventura and Santa Barbara counties, by W. L. Watts. 1897, 94 pp., 6 maps, 31 illustrations-----	-----
**Bulletin No. 12. Mineral Production of California, by Counties for 1896, by Charles G. Yale. Tabulated sheet-----	-----
**Bulletin No. 13. Mineral Production of California, by Counties for 1897, by Charles G. Yale. Tabulated sheet-----	-----
**Bulletin No. 14. Mineral Production of California, by Counties for 1898, by Charles G. Yale-----	-----
**Bulletin No. 15. Map of Oil City Fields, Fresno County, by John H. Means. 1899-----	-----
**Bulletin No. 16. The Genesis of Petroleum and Asphaltum in California, by A. S. Cooper. 1899, 39 pp., 29 illustrations-----	-----
**Bulletin No. 17. Mineral Production of California, by Counties for 1899, by Charles G. Yale. Tabulated sheet-----	-----
**Bulletin No. 18. Mother Lode Region of California, by W. H. Storms. 1900, 154 pp., 49 illustrations-----	-----
**Bulletin No. 19. Oil and Gas Yielding Formations of California, by W. L. Watts. 1900, 236 pp., 60 illustrations, 8 maps-----	-----
**Bulletin No. 20. Synopsis of General Report of State Mining Bureau, by W. L. Watts. 1901, 21 pp. This bulletin contains a brief statement of the progress of the mineral industry in California for the four years ending December, 1899-----	-----
**Bulletin No. 21. Mineral Production of California by Counties, by Charles G. Yale. 1900. Tabulated sheet-----	-----
**Bulletin No. 22. Mineral Production of California for Fourteen Years, by Charles G. Yale. 1900. Tabulated sheet-----	-----
Bulletin No. 23. The Copper Resources of California, by P. C. DuBois, F. M. Anderson, J. H. Tibbits and G. A. Tweedy. 1902, 282 pp., 69 illustrations, and 9 maps-----	.50
**Bulletin No. 24. The Saline Deposits of California, by G. E. Bailey. 1902, 216 pp., 99 illustrations, 5 maps-----	-----
**Bulletin No. 25. Mineral Production of California, by Counties, for 1901, by Charles G. Yale. Tabulated sheet-----	-----
**Bulletin No. 26. Mineral Production of California for the past Fifteen Years, by Charles G. Yale. 1902. Tabulated sheet-----	-----
**Bulletin No. 27. The Quicksilver Resources of California, by William Forstner. 1903, 273 pp., 144 illustrations, 8 maps-----	-----
**Bulletin No. 28. Mineral Production of California, for 1902, by Charles G. Yale. Tabulated sheet-----	-----
**Bulletin No. 29. Mineral Production of California for Sixteen Years, by Charles G. Yale. 1903. Tabulated sheet-----	-----
**Bulletin No. 30. Bibliography Relating to the Geology, Palæontology, and Mineral Resources of California, by A. W. Vogdes. 1903, 290 pp.-----	-----
**Bulletin No. 31. Chemical Analyses of California Petroleum, by H. N. Cooper. 1904. Tabulated sheet-----	-----
**Bulletin No. 32. Production and Use of Petroleum in California, by Paul W. Prutzman. 1904, 230 pp., 116 illustrations, 14 maps-----	-----
**Bulletin No. 33. Mineral Production of California, by Counties, for 1903, by Charles G. Yale. Tabulated sheet-----	-----

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**Bulletin No. 34. Mineral Production of California for Seventeen Years, by Charles G. Yale. 1904. Tabulated sheet.-----	-----
**Bulletin No. 35. Mines and Minerals of California, by Charles G. Yale. 1904, 55 pp., 20 county maps. Relief map of California.-----	-----
**Bulletin No. 36. Gold Dredging in California, by J. E. Doolittle. 1905, 120 pp., 66 illustrations, 3 maps.-----	-----
**Bulletin No. 37. Gems, Jewelers' Materials, and Ornamental Stones of California, by George F. Kunz. 1905. 168 pp., 54 illustrations.-----	-----
**Bulletin No. 38. Structural and Industrial Materials of California, by Wm. Forstner, T. C. Hopkins, C. Naramore and L. H. Eddy. 1906, 412 pp., 150 illustrations, 1 map.-----	-----
**Bulletin No. 39. Mineral Production of California, by Counties, for 1904, by Charles G. Yale. Tabulated sheet.-----	-----
**Bulletin No. 40. Mineral Production of California for Eighteen Years, by Charles G. Yale. 1905. Tabulated sheet.-----	-----
**Bulletin No. 41. Mines and Minerals of California, for 1904, by Charles G. Yale. 1905, 54 pp., 20 county maps.-----	-----
**Bulletin No. 42. Mineral Production of California, by Counties, 1905, by Charles G. Yale. Tabulated sheet.-----	-----
**Bulletin No. 43. Mineral Production of California for Nineteen Years, by Charles G. Yale. Tabulated sheet.-----	-----
**Bulletin No. 44. California Mines and Minerals for 1905, by Charles G. Yale. 1907, 31 pp., 20 county maps.-----	-----
**Bulletin No. 45. Auriferous Black Sands of California, by J. A. Edman. 1907. 10 pp.-----	-----
Bulletin No. 46. General Index of Publications of the California State Mining Bureau, by Charles G. Yale. 1907, 54 pp.-----	\$0.30
**Bulletin No. 47. Mineral Production of California, by Counties, 1906, by Charles G. Yale. Tabulated sheet.-----	-----
**Bulletin No. 48. Mineral Production of California for Twenty Years. 1906, by Charles G. Yale.-----	-----
**Bulletin No. 49. Mines and Minerals of California for 1906, by Charles G. Yale. 34 pp.-----	-----
Bulletin No. 50. The Copper Resources of California, 1908, by A. Hausmann, J. Kruttschnitt, Jr., W. E. Thorne and J. A. Edman, 366 pp., 74 illustrations. (Revised edition.)-----	1.00
**Bulletin No. 51. Mineral Production of California, by Counties, 1907, by D. H. Walker. Tabulated sheet.-----	-----
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Samples (limited to three at one time) of any mineral found in the state may be sent to the Bureau for identification, and the same will be classified free of charge. No samples will be determined if received from points outside the state. It must be understood that no assays, or quantitative determinations will be made. Samples should be in lump form if possible, and marked plainly with name of sender on outside of package, etc. No samples will be received unless delivery charges are prepaid. A letter should accompany sample, giving locality where mineral was found and the nature of the information desired.

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